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MEDICAL DEPARTMENT

TWENTIETH
ANNUAL REPORT

1931

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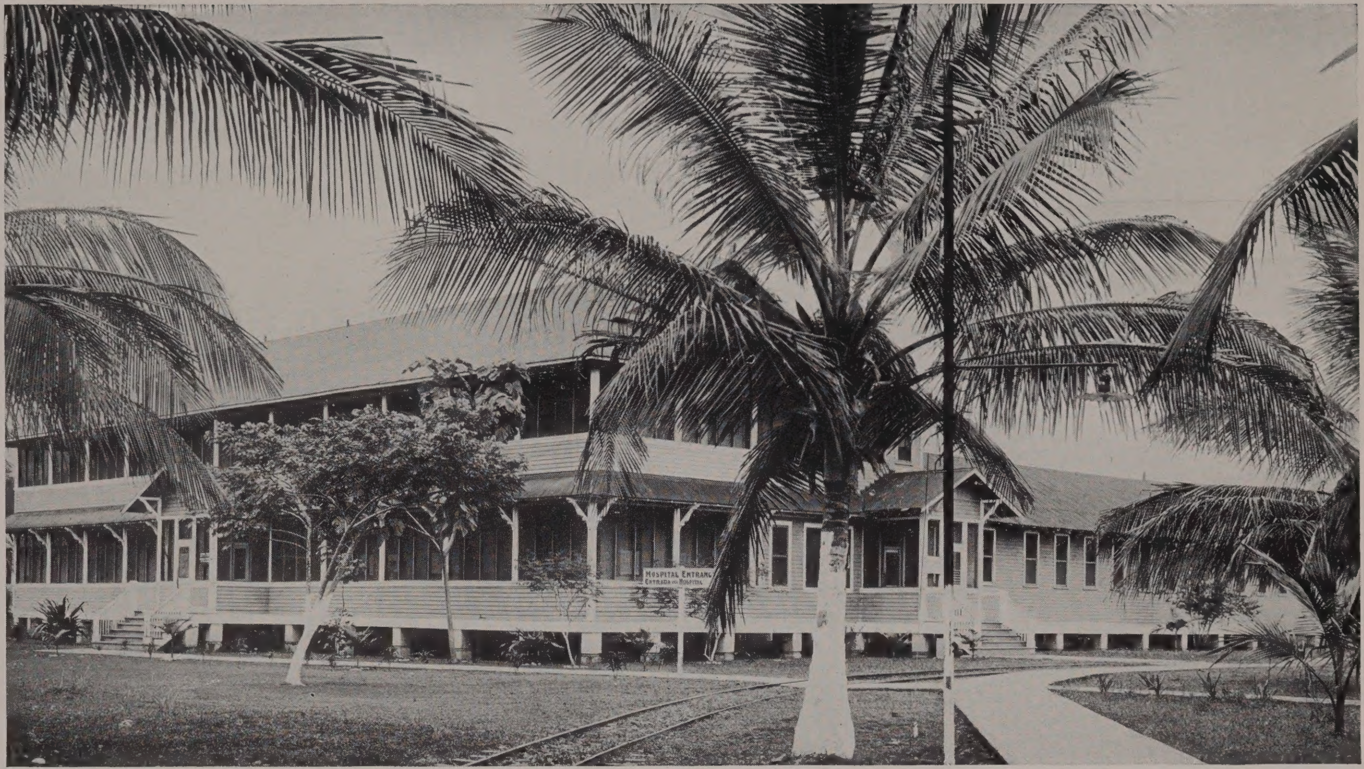
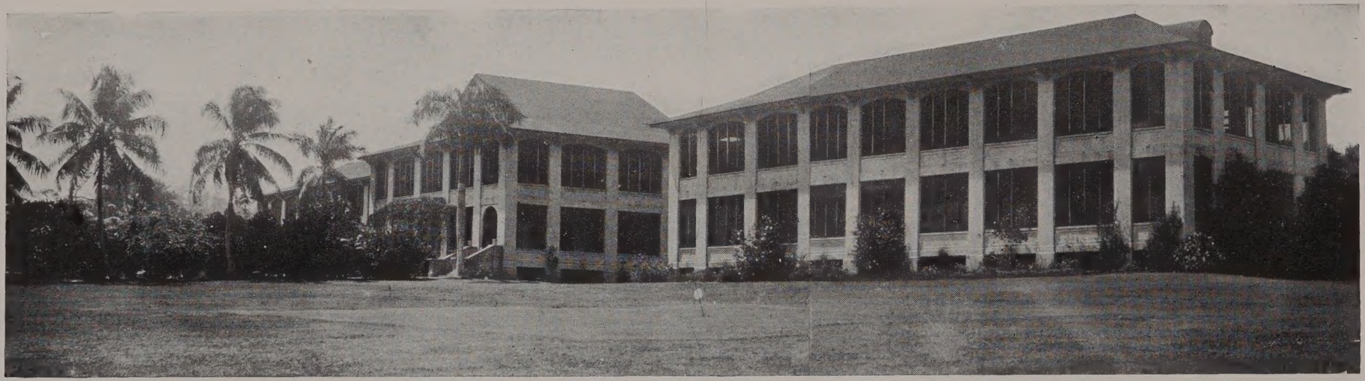
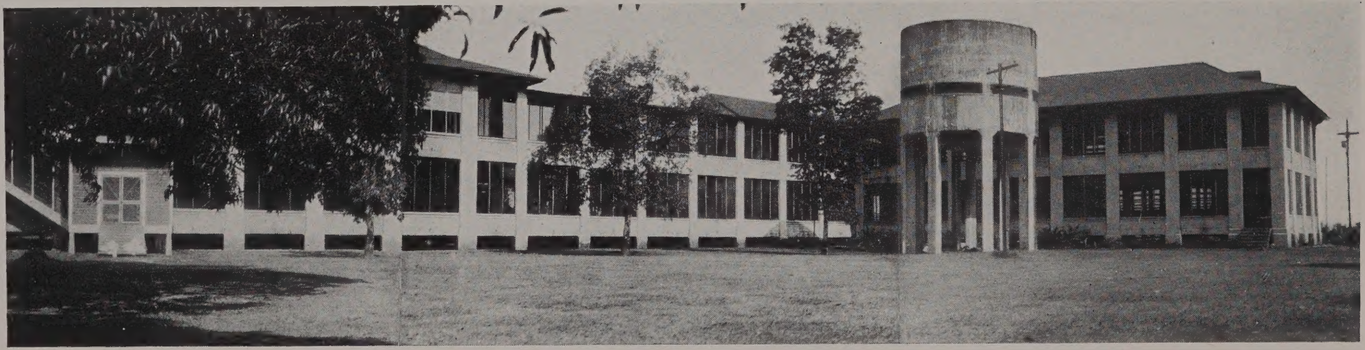
Compañia Bananera de Costa Rica Hospital at Port Limon, Costa Rica



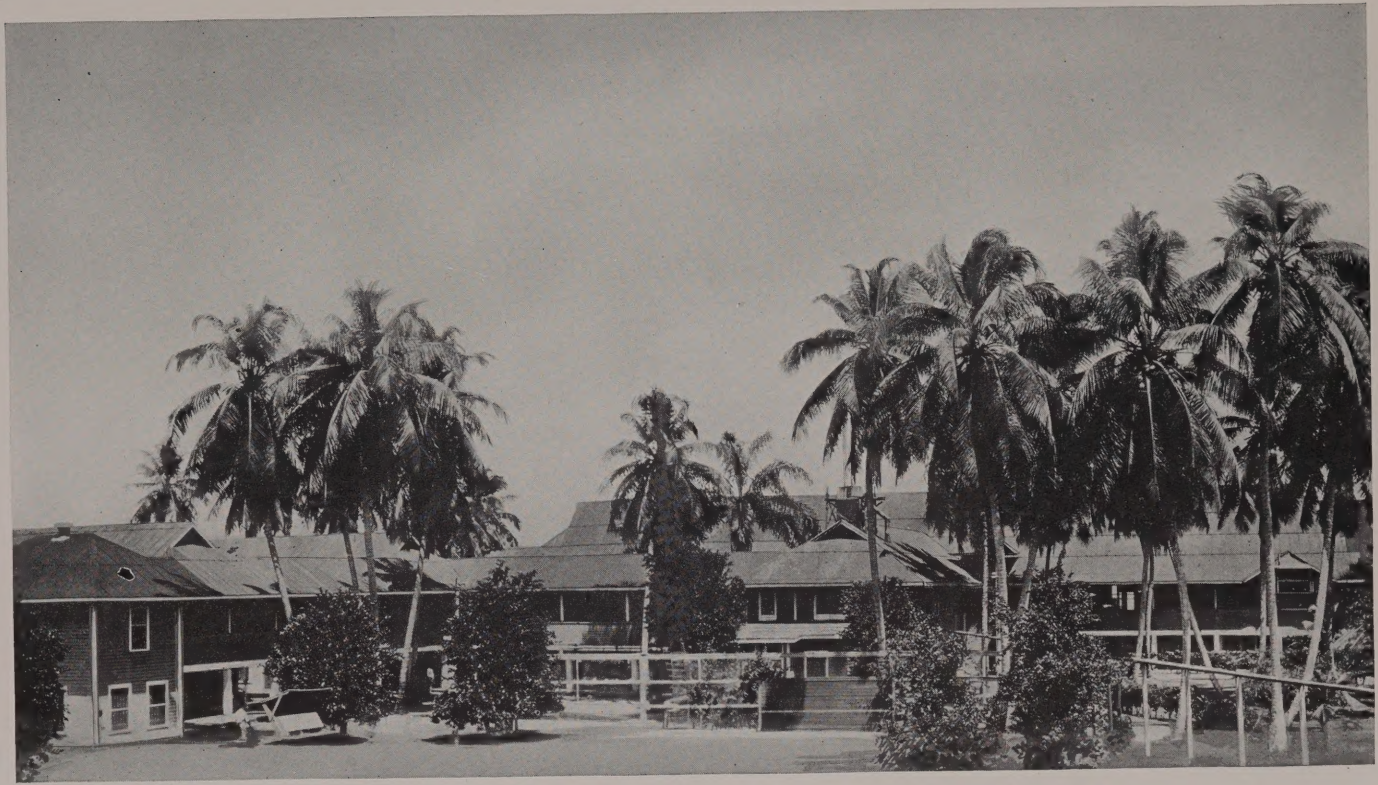
UNITED FRUIT COMPANY HOSPITAL AT ALMIRANTE, PANAMA



United Fruit Company Hospital at Quirigua, Guatemala (Front View)

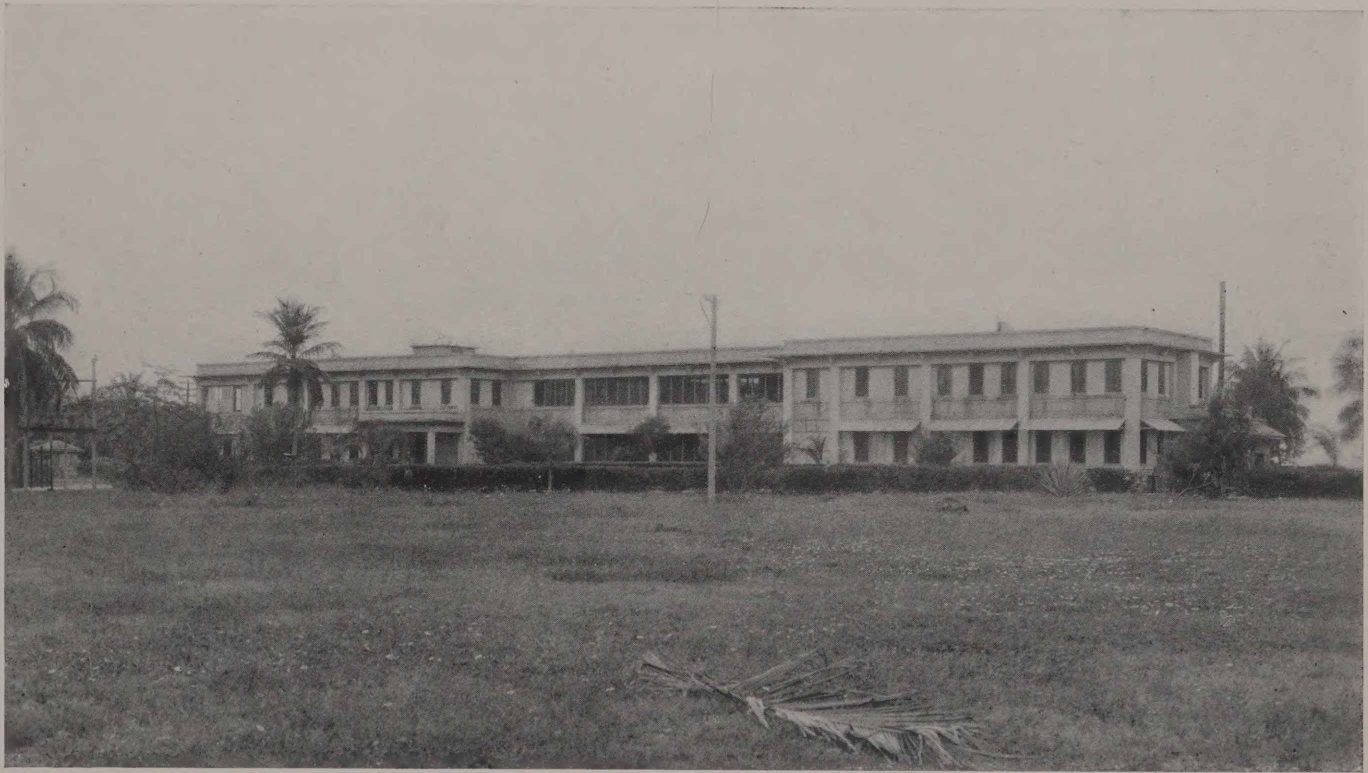


United Fruit Company Hospital at Quirigua, Guatemala (Rear View)

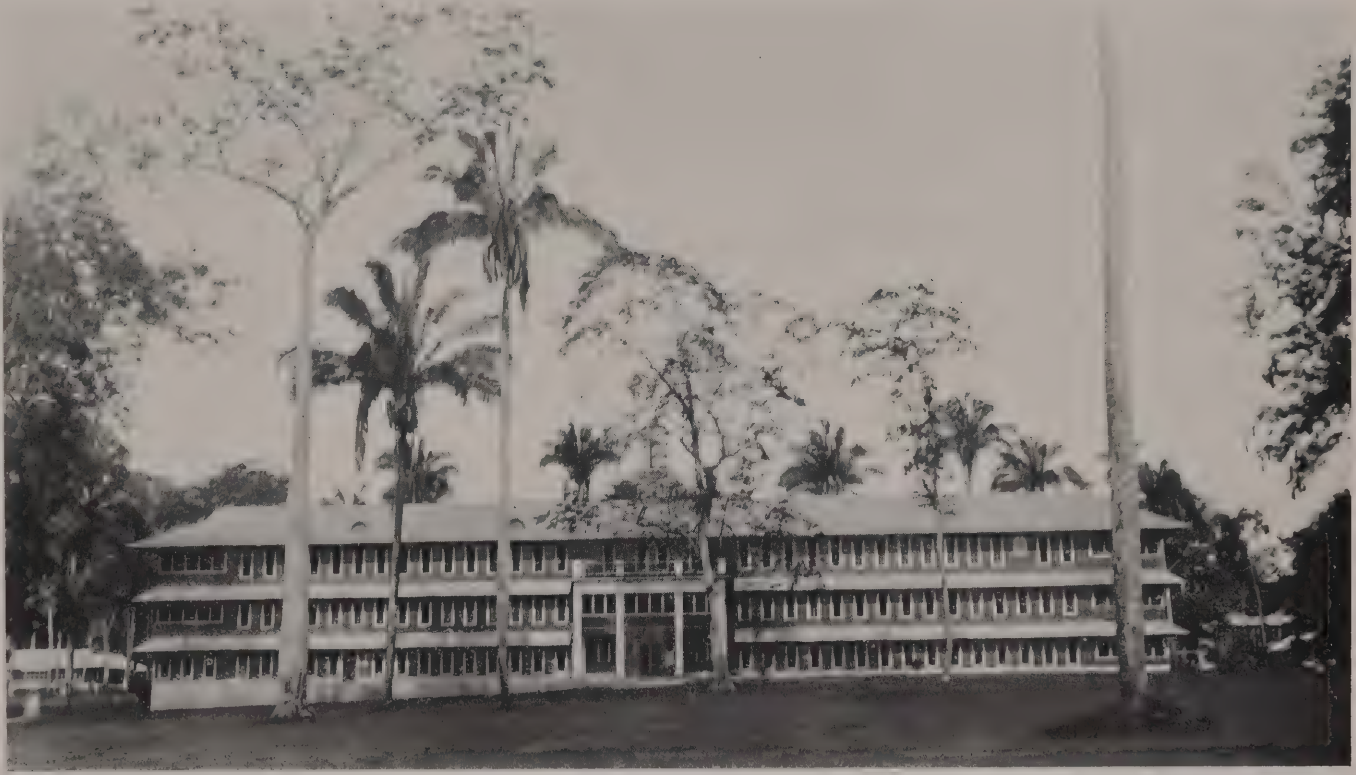


Tela Railroad Company Hospital at Tela, Honduras

REAR VIEW—FOLIAGE PREVENTS OBTAINING SATISFACTORY FRONT VIEW

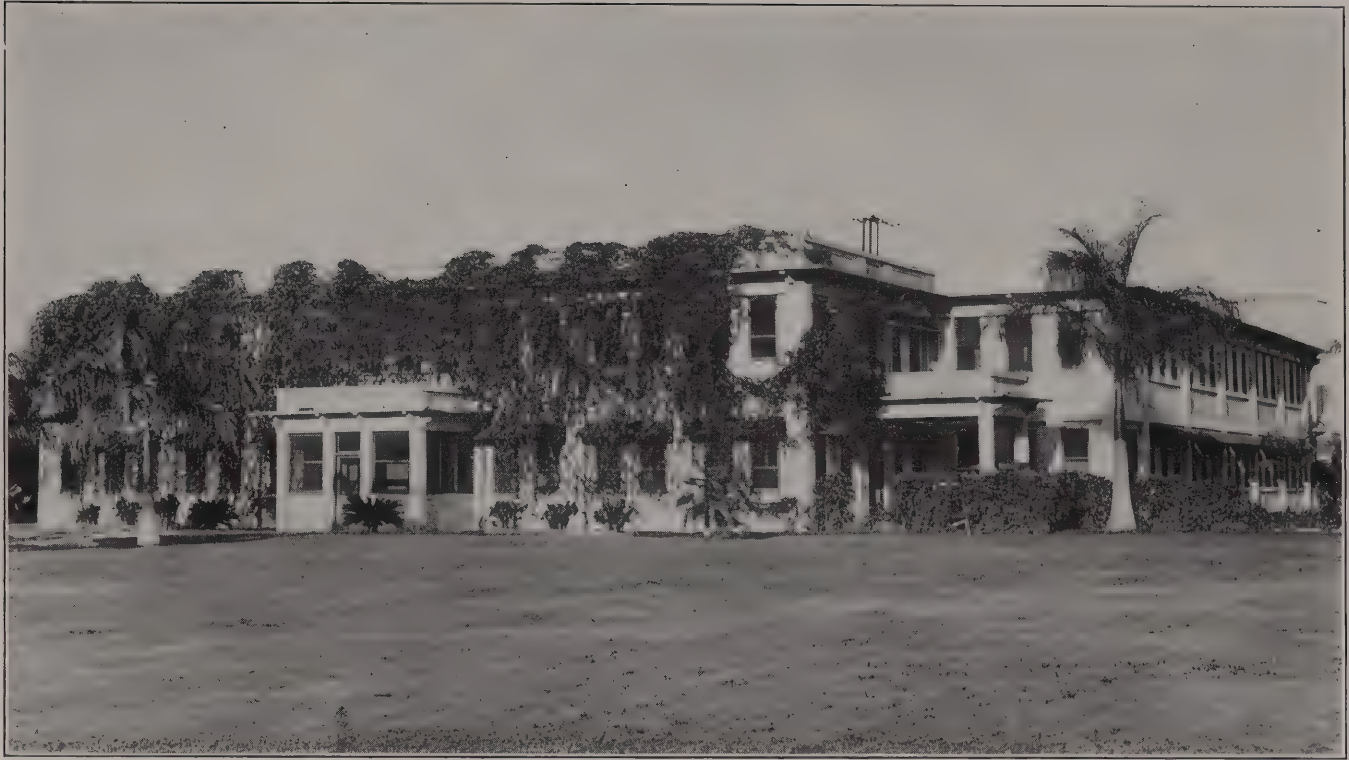


Truxillo Railroad Company Hospital, Puerto Castilla, Honduras



Chiriqui Land Company Hospital at Puerto Armuelles, Panama

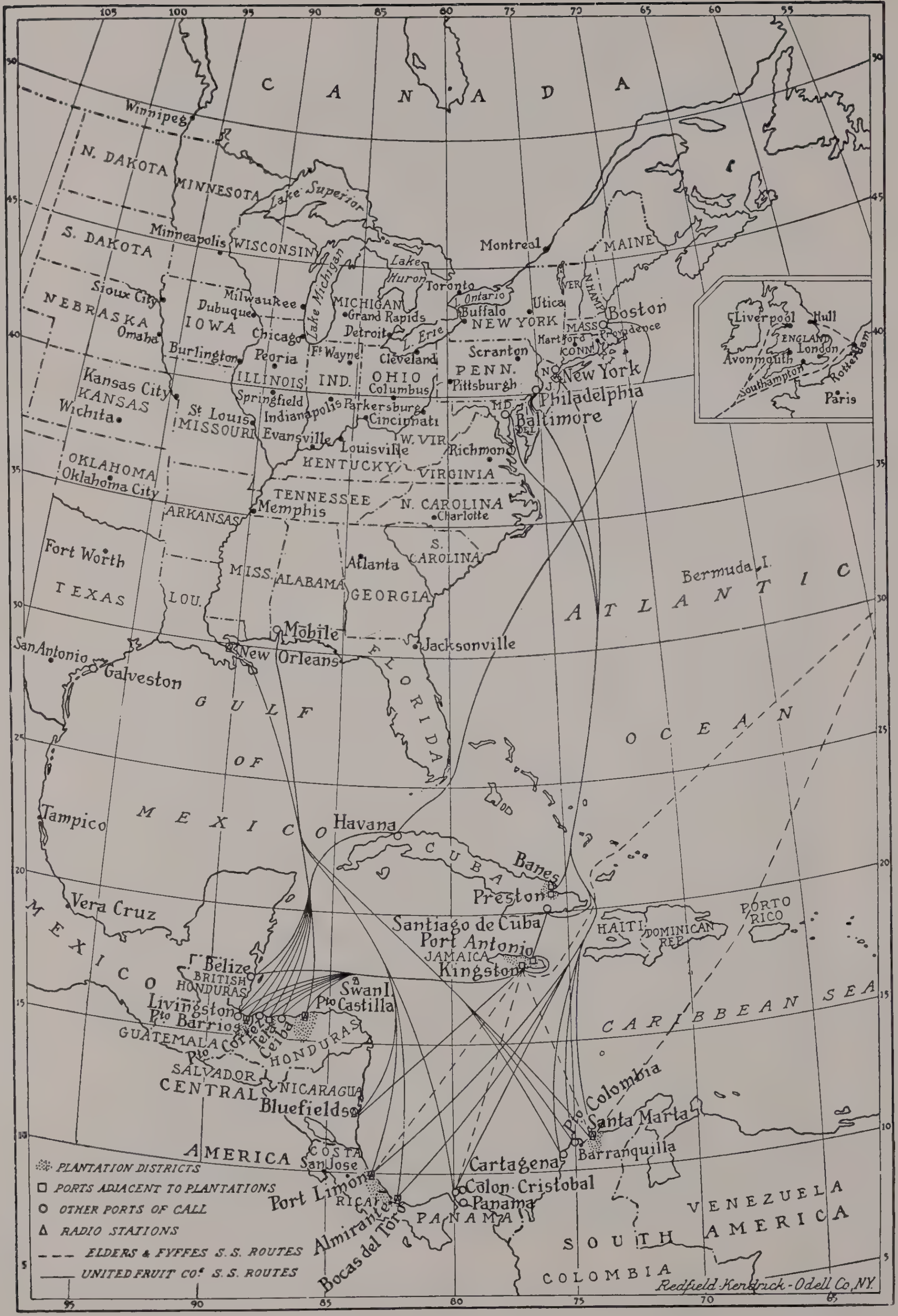
United Fruit Company Hospital at Banes, Cuba



UNITED FRUIT COMPANY HOSPITAL AT PRESTON, CUBA

United Fruit Company Hospital at Santa Marta, Colombia

New Emergency Hospital and Dispensary of United Fruit Company, at Sevilla, Colombia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RADIO STATIONS
ELDERS & FYFFES S.S. ROUTES
UNITED FRUIT COS. S.S. ROUTES
Redfield-Kendrick-Odell Co. N.Y.

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SPECIAL COMMENT

The author of each paper is afforded an opportunity to give free expression to his own ideas on the subject of the article, and it is understood that he is solely responsible for the opinions expressed and the statements made therein.

SECTION I

UNITED FRUIT COMPANY
MEDICAL DEPARTMENT

R. C. CONNOR, M.D.
GENERAL MANAGER

CABLE ADDRESS
UNIFRUITCO, NEW YORK

Pier 3, North River,
New York, N. Y.

May 1, 1932

Mr. V. M. Cutter, President
United Fruit Company
Boston, Massachusetts

Dear Sir:-

The annual Report of the Medical Department of the United Fruit Company for the fiscal year ended December 31st, 1931, is herewith submitted.

The Medical Department of the United Fruit Company and the world of tropical medicine in general suffered a great loss through the death of Dr. W. E. Deeks, on July 24th, 1931. By his sincere devotion to and intense interest in tropical diseases and preventive medicine, his thorough knowledge of the problems encountered in the warmer climates and the measures necessary to cope successfully with them, his numerous contributions to medical literature which he utilized as a medium for distributing widely among his fellow members of the medical profession the wisdom that he had gained from long practical experience and application so that it might be used for the general good of humanity, and his extensive contacts with people in all walks of life while pursuing his untiring and altruistic efforts to serve mankind; he achieved an outstanding recognition in medical circles throughout the world. His loss will be felt keenly for years to come.

No other important changes occurred in the personnel of the Medical Department during 1931. Furthermore, while material retrenchments have been made in the expenditures of the Department as a consequence of the continued financial depression, it is gratifying to state that it has not seriously handicapped the efficiency of our organization nor affected us in our efforts to maintain satisfactory health and sanitary conditions in the localities where our Company operates.

The vast improvement in transportation facilities, in the Cuban Divisions, has greatly expedited the conveyance of patients; and sick or injured persons from any locality in the plantations can reach a Hospital Dispensary or a Hospital without delay or inconvenience. Furthermore, the energetic and sustained campaigns waged during recent years against malaria and other preventable diseases has reduced morbidity in these Divisions to a very low rate. Under the circumstances, it has been considered advisable to consolidate the two Hospitals located formerly at Banes and Preston respectively; and all patients from both Divisions are now hospitalized in the Preston Hospital, with the exception of emergency and special cases which are temporarily hospitalized in the Banes Hospital. The accommodations and equipment of the Preston Hospital, supplemented by the Hospital Dispensaries located in farm centers and by the Banes Emergency Hospital, are such that the Medical Department of the Cuban Divisions continues to render prompt and efficient medical attention to all the employees and members of their families. Despite the fact that the organization was not functioning as one unit until the latter part of 1931; the statistics of the Medical Departments of the Preston Division and the Banes Division have been combined in this Report under the designation of "Cuban Divisions," as they will operate as one Department hereafter.

No serious epidemics of contagious or infectious diseases have occurred in any of our Divisions during the course of 1931; nor have we been confronted with any unusual or alarming situations in our efforts to control endemic and pandemic diseases. Elsewhere in this publication we have reviewed briefly the morbidity and mortality statistics for the more important and more prevalent ailments encountered, and have commented concisely upon them.

Members of our own medical staff, as well as individuals outside of our organization, have pursued certain lines of investigation during 1931 which we feel will develop new and improved methods for coping with malaria, dysentery and other diseases endemic in the tropical countries where we operate. Papers are published in this Report which record the present status of these investigations.

It is our desire to acknowledge our appreciation of the cooperation which we have received from various outside organizations; and particularly from the United States Public Health Service, the Rockefeller Foundation, and the Gorgas Memorial Laboratory. We are also indebted to Dr. H. C. Clark, Dr. W. M. James, Dr. R. P. Strong, and Dr. T. T. Mackie for valuable contributions to our Annual Report.

It is superfluous, perhaps, to state that any success which the Medical Department has attained in its efforts to maintain satisfactory health and sanitary conditions in the various localities where the Company operates is largely due to the liberal and farsighted policy of the executives and Directors of the United Fruit Company and to the loyal and wholehearted assistance rendered by all employees in charge of various operating units of the Company's organization—nevertheless, we desire to take this opportunity to express our sincere gratitude.

Respectfully,

R. C. Connor.

COMMENTS ON SOME OF THE MORE IMPORTANT DISEASES OCCURRING IN THE TROPICAL DIVISIONS

A brief review of the work of the Medical Department, and of the results accomplished, may be of interest. The extent and scope of the Company's activities and of the Medical Department's functions, may be realized from the data contained in the following concise statements:

1. The lands owned and leased by the Company total 3,456,387 acres, of which 470,649 acres are improved areas and 2,985,738 are unimproved areas.

2. The Company operated 2,350 miles of railways and tramways; and 105 steamships, with a gross tonnage of 435,455.

3. The number of employees of the Company during 1931 averaged 73,251; of which, 65,680 were located in the tropical Divisions, 4,747 in the domestic Divisions, and 2,824 in the steamship service. In addition, there were approximately 76,640 non-employees (families of employees and others) in the tropical Divisions who were dependent upon the Company's facilities for medical attention.

4. The principal units of the Medical Department are: (a) 10 Hospitals, with a total bed capacity of 1,575, which can be increased to 2,100 or more in emergencies; (b) Hospital Dispensaries, Field Dispensaries, "Sick-Camps," and "Line Hospitals" located at points in the tropical Divisions which are some distance from the Hospitals and which have large concentrations of populations; (c) Port Medical Offices at the more important domestic ports; and (d) physicians aboard passenger-carrying steamers.

5. The personnel of the Medical Departments includes 45 physicians and laboratory technicians, 39 registered and graduate nurses, 41 dispensers, 12 sanitary inspectors, and 489 minor employees.

6. During 1931, 22,782 patients were treated in the Hospitals, with a total of 263,483 hospital days; 373,699 treatments were administered at Hospital and Field Dispensaries; 55,803 persons were examined for malarial parasites during field surveys; 12,793 patients received medical attention aboard steamships or at Port Medical Offices; 533 prospective employees were given physical examinations; and 28,140 prospective employees aboard steamers were examined on "Signing-on" days.

7. The average daily number of patients in the Hospitals was 724. Of these, 23 (3.2%) were employees from the temperate zone; 25 (3.4%) were non-employees from the temperate zone; 479 (66.2%) were other employees; and 197 (27.2%) were other non-employees—i.e., a total of 502 (69.3%) employees, and 222 (30.7%) non-employees.

8. The average daily number of patients treated at Dispensaries was 1,027. Of these, 37 (3.6%) were employees from the temperate zone; 17 (1.7%) were non-employees from the temperate zone; 705 (68.6%) were other employees;

and 268 (26.1%) were other non-employees—i.e., a total of 742 (72.2%) employees and 285 (27.8%) non-employees. In addition, there was an average of 153 individuals examined daily during malaria surveys; and all of these who were obviously ailing, received medical attention.

9. To summarize the comments in the two preceding paragraphs: The number of persons who received medical attention in the tropical Divisions averaged 1,904 daily during 1931.

The more salient statistics pertaining to employees of tropical Divisions are as follows:

	Aver. No. of Employees Under Medical Supervision	Aver. Daily Number in Hospitals	Aver. Daily Number Treated at Dispensaries	Aver. No. Non-effective Per Thousand	Aver. No. Partially Noneffective Per Thousand	Death Rate Per Thousand
Temp. Zone . .	1,817	23	37	12	20	8.26
Others	54,591	479	705	9	13	8.90
Total	56,408	502	742	9	13	8.88

While the "Non-effective Rate" and the "Partially Non-effective Rate" for employees from the temperate zone are noticeably higher than the rates for other employees (principally natives of the respective countries), this must not be construed as indicating that the former class of employees is more prone to contract ailments or that the morbidity rate is actually greater. The employees from the temperate zone will seek medical advice, and even request admission to the hospitals, for minor ailments; while, as a general rule, laborers will defer seeking medical advice until they are suffering acutely, will decline to accept hospitalization unless they are seriously ill, and will demand that they be discharged from the hospital as soon as they are feeling fairly well and the active symptoms have subsided.

The accompanying Table A shows approximately the amount of morbidity, the time lost from labor because of illness or injury, and the death rates, for employees. A few explanatory remarks regarding the statistics appearing in Table A, may be instructive:

Death Rate per Thousand Employees.—It will be observed that the death rates vary considerably, in the different Divisions and from year to year. This will be readily understood by statisticians; when it is taken into consideration that the number of employees in each Division is comparatively small (ranging from 2,000 to 15,000) and, consequently, that a few additional deaths from an unusual cause will materially increase the death rate. As an example, we may cite the Truxillo Division for 1931—there were 99 deaths recorded among employees, of which 61 were due to violence; and, of these 61, 52 died before medical attention could be given to them while 8 died within from 2 hours to 6 days after hospital admission. The vast majority of these 61 deaths were the direct result of fighting or physical attacks, and one or more of the combatants or victims were killed almost instantly. Including these 61 deaths, the Truxillo Division shows a death rate of 21.54 per 1,000 employees; while, if we exclude the 61 deaths due to violence, the death rate for the Division would be 8.27 per 1,000 employees. A statement made by

TABLE A

Year	Chiriqui Land Co.	Colombia Division	Cortes Development Company	Cia. Bananera Costa Rica	Cuban Divisions	Guatemala Division	Jamaica Division	Panama Division	Tela Railroad	Truxillo Railroad	Total, excluding Jamaica Division	Total
Death Rate per Thousand Employees												
1931	14.36	6.05	15.08	15.30	6.92	7.92	.90	19.87	5.92	21.54	11.09	8.88
1930	14.08	7.35	—	12.87	6.09	9.72	.93	10.66	8.07	18.45	10.04	7.58
1929	7.27	7.25	—	14.03	6.68	13.71	.85	13.72	6.67	15.05	9.49	7.13
1928	—	6.52	—	13.94	7.40	10.57	1.41	15.99	12.32	13.75	10.42	8.47
1927	—	9.42	—	13.21	11.92	13.25	1.74	18.90	10.18	11.62	11.99	9.82
Hospital Admission Rate per Thousand Employees												
1931	362	353	540	368	157	372	3	232	425	405	331	260
1930	408	520	—	336	172	454	4	192	452	484	365	267
1929	283	546	—	414	201	378	2	446	484	555	386	282
1928	—	380	—	521	244	414	2	600	578	529	426	334
1927	—	373	—	615	340	490	3	550	614	471	464	366
Average Number of Employees Non-effective, per Thousand												
1931	8.52	14.07	11.52	17.71	6.18	11.70	.08	7.04	18.68	9.30	11.34	8.90
1930	9.68	19.45	—	16.63	6.12	13.81	.10	5.98	18.83	12.26	12.76	9.34
1929	6.79	18.83	—	18.48	7.38	12.54	.09	17.14	18.50	18.66	14.03	10.23
1928	—	13.37	—	19.90	8.07	10.08	.08	24.04	19.79	17.54	14.59	11.45
1927	—	13.58	—	22.03	9.44	15.67	.09	22.31	22.14	16.14	15.85	12.51
Average Number of Employees Partially Non-effective, per Thousand												
1931	15.95	27.25	12.61	20.69	6.80	11.97	5.40	9.51	22.09	16.41	15.29	13.15
1930	18.66	26.57	—	17.46	6.37	10.59	4.14	9.22	16.16	10.51	13.91	11.27
1929	34.01	21.32	—	11.70	6.00	12.43	3.79	21.81	14.22	8.62	13.64	10.95
1928	—	15.76	—	8.70	7.54	12.17	5.60	19.72	13.88	6.91	11.27	10.14
1927	—	17.39	—	8.37	7.07	9.37	4.58	16.84	13.26	6.18	10.75	9.44
Average Number of Employees Non-effective or Partially Non-effective, per Thousand												
1931	24.47	41.32	24.13	38.40	12.98	23.67	5.48	16.55	40.77	25.71	26.63	22.05
1930	28.34	46.02	—	34.09	12.49	24.40	4.24	15.20	34.99	22.77	26.67	20.61
1929	40.80	40.15	—	38.10	13.38	24.97	3.88	38.95	32.72	27.28	27.67	21.18
1928	—	29.13	—	28.60	15.61	22.25	5.68	43.76	33.67	24.45	25.86	21.59
1927	—	30.97	—	30.40	16.51	25.04	4.67	39.15	35.40	22.32	26.60	21.95

Dr. R. B. Nutter, Medical Superintendent of the Tela Railroad Company, will serve to further illustrate this point: "*Violence and moribund admissions (less than 24 hours in the Hospital before death occurs) continue to account for 50% of the deaths.*" Despite these local irregularities, however; the death rates for all Divisions combined, for the respective years, are fairly uniform—the larger number of employees thus grouped seemingly equalizing the unusual conditions which may exist in any specific locality during a given period of time.

Hospital Admission Rate per Thousand Employees.—In general, all Divisions have shown a reduced rate from year to year since 1925; although local conditions have occasionally caused a temporary increase in some Divisions. Elsewhere in this article, it has been explained that the reduced hospitalization rates are attributed to sanitation, anti-malarial work, and intensified supervision of laborers' quarters.

Average Number of Employees Non-effective, per Thousand.—The "Non-effective" rate records the average number of employees, per thousand employees, who were hospitalized; while the "Partially Non-effective" rate records the average number of employees, per thousand employees, who sought medical advice or treatment at the dispensaries daily. These rates are based upon the fact that a person confined to the hospital is totally incapacitated for labor—hence "non-effective;" and upon the assumption that the average patient calling at a dispensary for medical attention will be absent from his duties only part of the day, and hence is "partially non-effective." It is interesting to note that the total "Non-effective" and "Partially Non-effective" employees of all Divisions are approximately the same from year to year; ranging between 20.61 and 22.05 per thousand.

CAUSES OF MORBIDITY AND MORTALITY

The following Table B will give a general idea of the diseases which were responble for the morbidity and mortality in the tropical Divisions during 1931.

In Table B, we have not mentioned specifically a number of diseases which are not encountered in our Divisions as frequently as those which are listed individually, but which are of interest because of their world-wide prevalence and general importance from a morbidity or mortality standpoint. Table C records the incidence of a number of these latter conditions.

Those diseases which are responsible for the greater percentage of the morbidity and mortality of the persons dependent upon the Medical Department of the United Fruit Company will be commented upon separately, in the following text. Particular attention will be devoted to the statistics pertaining to employees; as they rely more fully upon the Company for treatment than do the non-employees, and the census figures for the latter are only estimated while those for employees are taken from the actual payrolls.

MALARIA.—The economic importance of malaria, and the high rate of morbidity occasioned by this disease, merits giving it primary consideration; and, in consequence, the subject of malaria-control has been reviewed at length in a separate section of this paper—page 17.

TYPHOID AND PARATYPHOID.—There were 224 hospital cases reported during 1931—94 employees, and 130 non-employees; with 22 deaths and 19 deaths, respectively, all of which occurred in the Hospitals. Vital statistics for employees: morbidity rate 166.6 per 100,000; mortality rate, 39.0 per 100,000; fatality rate, 23.40 per 100 cases. While each Division reported one or more cases, the vast majority of them occurred in Colombia (82), Costa Rica (44), Cuba (66) and Tela (19). These four Divisions reported 211 cases, of the total of 224 cases. Typhoid is endemic in the native quarters, over which the Company exercises no control. Every effort is made by the Company to prevent the spread of any contagious disease, and the efforts have been very successful in most instances as will be observed by referring to the Statistical Section; but it is impossible to eradicate many of these diseases, due to the fact that the

TABLE B

CAUSE OF MORBIDITY AND MORTALITY ACCORDING TO PERCENTAGE OF FREQUENCY

	Hosp. Cases	Percentage of Hosp. Cases	Hospital Disp. Treat.	Percentage of Disp. Treat.	Total Deaths	Percentage of Total Deaths
Typhoid and Paratyphoid Fevers	224	1.00	—	—	41	3.86
Malaria	4,918	22.06	30,914	12.30	91	8.57
Influenza	1,440	6.46	17,922	7.13	16	1.51
Dysentery	648	2.91	4,780	1.90	14	1.32
Tuberculosis.	400	1.79	—	—	59	5.56
Venereal Diseases	1,179	5.29	12,581	5.00	14	1.32
Other Epidemic, Endemic or Infectious Diseases . . .	321	1.44	1,541	.61	30	2.82
Other General Diseases . . .	643	2.88	10,734	4.27	46	4.33
Diseases of the Nervous System	845	3.79	11,079	4.41	47	4.43
Diseases of the Heart . . .	199	.89	605	.24	85	8.00
Other Diseases of the Circulatory System	378	1.70	3,023	1.20	15	1.41
Bronchitis.	584	2.62	10,723	4.27	10	.94
Pneumonia	392	1.76	402	.16	168	15.82
Pleurisy	119	.53			1	.09
Other Diseases of the Respiratory System.	214	.96	5,473	2.18	8	.75
Diarrhea and Enteritis . . .	245	1.10	3,408	1.36	56	5.27
Ankylostomiasis	377	1.69	2,006	.80	1	.09
Other Diseases of the Digestive System	1,917	8.60	26,386	10.49	45	4.24
Acute and Chronic Nephritis.	219	.98	—	—	48	4.52
Other Non-Venereal Diseases of the Genito-Urinary System	926	4.15	6,091	2.42	11	1.04
The Puerperal State	852	3.82	865	.34	28	2.64
Phlegmon, Acute Abscess . .	725	3.25	10,075	4.01	—	—
Ulcer of the Skin.	409	1.83	14,649	5.83	—	—
Other Diseases of the Skin and Adnexa	614	2.75	19,361	7.70	2	.19
Diseases of the Bones. . . .	300	1.35	2,869	1.14	1	.09
Malformations.	13	.06	10	.00	2	.19
Diseases of Early Infancy . .	63	.28	155	.06	42	3.96
Old Age.	10	.05	50	.02	7	.66
Injury by Firearms, Instruments and Falls	1,400	6.28	18,783	7.47	118	11.11
Traumatisms by Machines, etc..	256	1.15	3,286	1.31	16	1.51
Other External Causes . . .	716	3.21	8,885	3.53	27	2.54
Ill-Defined Diseases	751	3.37	24,766	9.85	13	1.22
*Totals	22,297	100.00	251,422	100.00	1,062	100.00

* NOTE.—In the Field Dispensaries, where the medical attention is given by trained Dispensers, there was a total of 122,277 treatments. While these Dispensers perform a useful function by providing competent "first-aid" treatment, their diagnoses are naturally symptomatic; and consequently they are not recorded in this Report, but are divided merely into medical and surgical cases of which there were 86,844 and 35,433 respectively.

TABLE C

	Hospital Cases			Hospital Dispensary Treatments			Deaths		
	*Emp.	Non-Emp.	Total	Emp.	Non-Emp.	Total	Emp.	Non-Emp.	Total
Smallpox	14	7	21	—	—	—	—	—	—
Measles	12	12	24	19	87	106	—	—	—
Whooping Cough	—	8	8	23	210	233	—	—	—
Diphtheria	3	12	15	2	29	31	—	—	—
Mumps	69	6	75	85	24	109	—	—	—
Leprosy	7	1	8	12	1	13	—	1	1
Varicella	26	8	34	105	46	151	—	—	—
Dengue	2	2	4	—	—	—	—	—	—
Yaws	32	—	32	26	22	48	—	—	—
Cancer	34	39	73	14	15	29	14	10	24
Benign Tumors	35	21	56	207	128	335	2	1	3
Beriberi	14	2	16	65	4	69	—	—	—
Diabetes	4	12	16	22	23	45	1	2	3
Pernicious Anemia	17	27	44	43	57	100	1	2	3
Cerebral hemorrhage, apoplexy	15	10	25	1	9	10	7	7	14
Snake-bites	36	14	50	20	1	21	1	1	2

* Included in this column, are 1 case each of measles, diphtheria and benign tumor, and 2 cases each of cancer and pernicious anemia which occurred among employees from the temperate zone. The other cases were "Other Employees."

employees and others dependent upon the Company for medical attention pass a considerable portion of their leisure hours outside of the areas under the jurisdiction of the Company and hence expose themselves to infections endemic or prevalent in many of the localities adjoining our plantations. Interesting articles by Dr. P. S. Malaret have been contributed to this Report and the 1930 Report, in which he describes the obstacles encountered in endeavoring to control typhoid in Banes, Cuba, and refers to efforts made to immunize the population by inoculation. With slight modifications, his remarks regarding the difficulties experienced in Banes will apply to other localities where we operate. However, the following abstracts from reports rendered by the Medical Superintendents of Divisions where typhoid appeared during 1931 may be of interest:

Dr. L. M. Drennan, Colombia Division.—The epidemic of typhoid fever here was water borne. Proof of this was demonstrated in the various analyses we made of the city water supply, which showed excessively high pollution, and by the fact that in the town of Cienaga, which is admittedly larger and less sanitary, there was no mention of an increased incidence of this disease over previous years. This epidemic was confined to the township of Santa Marta and, to my knowledge, the worst on record. It bore no relation whatever to areas over which we have sanitary jurisdiction. Our recommendations for immediate chlorination of the water supply, when put into effect, soon caused a rapid subsidence of the epidemic. This measure was also augmented by the city Mayor prohibiting local vendors from peddling polluted well water. The remote cause of this epidemic was no doubt attributable to unusually heavy seasonal rains, following a prolonged drought, which covered wide areas of contaminated soil and thereby polluted all water supplies. There were 82 cases admitted to the Hospital, 19 of whom died—a fatality rate of 23%. Of the 82 cases, 24 were employees of the Company who worked or resided in and around

Santa Marta; and 9 of these 24 patients died. However, these 82 cases represented only a small percentage of the actual number of cases treated in the city. Many of the deaths could be attributed undoubtedly to the severity of the disease, their late arrival in the Hospital, lack of proper nursing facilities at home (so important in this disease), and the inherent debilitated condition of the average native.

Dr. E. I. Salisbury, Compania Bananera de Costa Rica Division.—The only cloud in the year's work was the prevalence of intestinal diseases, including typhoid and paratyphoid fever, and the large amount of malaria in Guacimo—the site of our new planting. Unsatisfactory water supply was, no doubt, a large factor in the prevalence of intestinal infections. Although typhoid fever was epidemic in the area which included our Division properties, it was not present in any Company property except the new camp at Guacimo. At one time, 1,300 men, women and children occupied this new camp; and, with a high water table, all wells were easily contaminated. The Annual Report shows a total of 44 cases of typhoid and paratyphoid. However, five additional cases were admitted late in 1931 and discharged in 1932; and these many be included as part of the epidemic, making a total of 49 cases for the year. There were 11 deaths, with a fatality rate of 22.4%.

Dr. J. de la Guardia, Cuban Divisions.—Our typhoid cases have decreased greatly as compared with the preceding year; and we are inclined to attribute this decrease to the immediate hospitalization of all typhoid suspects and the general vaccination of all the members of the families and of neighbors. We have carried out a campaign of intensive vaccination against smallpox and typhoid in the whole Division; and, as soon as the roads allow better transportation, we shall renew this work. Special reports by Dr. P. S. Malaret, regarding the cases which occurred during the year and also on the results of agglutination tests, will be published.

Dr. R. B. Nutter, Tela Railroad Company Division.—There were 19 cases of typhoid fever; but no epidemic occurred, and the source of infection could not be traced.

Dr. I. W. McLean, Jamaica Division.—We have continued our usual prophylactic measures against typhoid and other bowel diseases, by giving careful attention to the water supply, by fly-proofing all pit latrines, and by the usual biennial typhoid vaccination of our first-class employees and their families as well as vaccination of all laborers who might have been in contact with any case of typhoid fever which appeared on our estates.

INFLUENZA.—There were 1,440 hospital cases in 1931—1,131 employees, and 309 non-employees; with 11 and 5 deaths, of which 9 and 3 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 2005.0 per 100,000; mortality rate, 19.5 per 100,000; fatality rate, 8.0 per 1,000. These cases were distributed generally between the various Divisions; and no locality experienced an actual epidemic.

AMOEBIC DYSENTERY.—There were 481 hospital cases of amoebic dysentery—341 employees, and 140 non-employees; with 6 deaths and 6 deaths respectively, all of which occurred in the Hospitals. Vital statistics for employees: morbidity rate, 604.5 per 100,000; mortality rate, 10.64 per 100,000; fatality rate, 1.8 per 100 cases. Each Division reported one or more cases; but the majority of them occurred in the Cortes Development Company (161) and the Cia. Bananera de Costa Rica (145). These two Divisions reported 306 cases, of the total of 481 cases.

BACILLARY DYSENTERY.—Only 10 cases of bacillary dysentery were reported; while there were 53 cases recorded as unspecified or due to other causes than

E. histolytica or *B. dysenteriae* infection. These cases were scattered throughout the various Divisions, and no epidemic occurred in any locality.

TUBERCULOSIS.—There were 400 hospital cases in 1931—289 employees and 111 non-employees; with 38 and 21 deaths, of which 33 and 13 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 512 per 100,000; mortality rate, 67 per 100,000; fatality rate 11.4 per 100 cases. In addition to the 38 deaths among employees, there were 132 employees who were repatriated or sent to their homes in higher altitudes where the chances of recovery were better—therefore, the mortality and fatality rates for this disease are obscured and the figures given above are not deemed to be accurate. The cases were more or less uniformly distributed throughout the several Divisions; and the only conclusions which can be derived from the statistics available are (1) that tuberculosis is very prevalent in the coastal plains of Central America, and (2) that the disease is responsible for a high mortality rate in those localities.

VENEREAL DISEASES.—There were 1,179 hospital cases in 1931—874 employees and 305 non-employees; with 10 and 4 deaths, of which 10 and 2 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 1,549 per 100,000; mortality rate 18 per 100,000; fatality rate, 1.1 per 100 cases. The number of individuals requiring hospitalization for social diseases will give only a vague idea of the prevalence of these infections; and it may be said, in addition, that venereal diseases probably rank next to malaria as a cause of lowered vitality and resistance in the tropical countries where our plantations are located. Their enervating and debilitating effects undoubtedly are as prevalent and more destructive of human energy and life than those of hookworm and other affections of tropical locations which are usually held responsible for the lethargy and indolence so frequently exhibited by the natives of the warmer climates. An abstract from the report of Dr. R. B. Nutter, Medical Superintendent of the Tela Railroad Company Division, will convey some idea of the seriousness of this problem: "*The venereal and violence problem shows no improvement over 1930. In the following table I have compared the Hospital Days for these conditions during the past three years:*

	1929	1930	1931
Total Hospital days . . .	*59,889*	*60,048*	*41,593*
Hospital days for venereal diseases	*4,346 (7.3%)*	*3,045 (5.1%)*	*3,395 (8.2%)*
Hospital days for violence.	*5,490 (9.2%)*	*3,531 (5.9%)*	*5,109 (12.3%)*

Figures for 'Violence,' in 1931, include days of hospitalization of soldiers admitted for treatment during the recent revolution."

OTHER EPIDEMIC, ENDEMIC OR INFECTIOUS DISEASES.—The following table will indicate the relative unimportance of diseases of this group, with the exceptions of typhoid, malaria, influenza, dysenteries, tuberculosis, and venereal diseases:

TABLE D

	Cases			Deaths		
	Emp.	Non-Emp.	Total	Emp.	Non-Emp.	Total
Smallpox	14	7	21	—	—	—
Measles	12	12	24	—	—	—
Whooping cough	—	8	8	—	—	—
Diphtheria	3	12	15	—	—	—
Mumps	69	6	75	—	—	—
Ictero-hemorrhagica spirochetosis	8	4	12	1	2	3
Leprosy	7	1	8	—	1	1
Erysipelas	26	15	41	—	1	1
Epidemic cerebrospinal meningitis	1	—	1	—	—	—
Varicella	26	8	34	—	—	—
Filariasis	2	2	4	—	—	—
Dengue	2	2	4	—	—	—
Yaws	32	—	32	—	—	—
Purulent or septicemic infection	16	11	27	12	4	16
Tetanus	5	7	12	2	6	8
Mycoses	2	—	2	1	—	1
Other epidemic diseases	1	—	1	—	—	—
Total	226	95	321	16	14	30

No cases of typhus fever, relapsing fever, Malta fever, scarlet fever, miliary fever, Asiatic fever, Cholera nostras, plague, yellow fever, acute poliomyelitis, alastrim or Kaffir milkpox, glanders and farcy, malignant pustule (anthrax), rabies; nor of any other serious epidemic, endemic or infectious diseases (except those mentioned in Tables B and C) were treated in 1931. Furthermore, no cases of pellagra nor rickets occurred.

SMALLPOX.—Nineteen, of the 21 cases reported, occurred in the Honduras Divisions; but general vaccination throughout our plantations brought the epidemic under control, or such nominal control as is practicable in a district where the population is widely scattered and there is a very large turn-over of labor with the constant influx of non-immunes and possible carriers from the surrounding unsanitated and uncontrolled areas. *Dr. B. M. Phelps, the Medical Superintendent of the Truxillo Railroad Company Division (Honduras)*, where most of the cases occurred, stated:

> "In our Annual Report of last year, we reported the discovery of a case of smallpox imported from Nicaragua. This resulted in a small epidemic which was quite difficult to control on account of the migrating habits of the people concerned. There were no further cases reported after the control of this epidemic, until a case was discovered in Maloa District early in November; and, later, two other cases developed in Cuaca District. The cases were isolated; and all of the unvaccinated inhabitants were vaccinated. During the month of December, other isolated cases of smallpox occurred in our territory. Owing to the fact that chickenpox is common and endemic, the diagnosis is sometimes difficult. All cases seen have been of the discrete type, and the symptoms of most were very mild. It is interesting to note that one of the cases with the most profuse eruption was vaccinated and exposed to the disease practically simultaneously. At the

time he was admitted to the Hospital, he had an active, well-developed vaccination in addition to his smallpox lesions. Though the lesions on the face were nearly confluent, there was practically no scarring."

Dr. R. B. Nutter, Medical Superintendent of the Tela Railroad Company Division (Honduras), reported: "Two cases of smallpox developed in April, and were admitted to the Hospital. As a consequence, it was decided to vaccinate all our employees and their families, as well as the inhabitants of several villages adjacent to our properties. In all, a total of 10,000 persons were vaccinated. This measure was effective; and no epidemic developed."

Dr. F. C. Watson, Medical Superintendent of the Cortes Development Company (Honduras) advises that: "No cases of smallpox were observed during the year. However, a small epidemic of chickenpox occurred in the spring. Owing to the severity of many of the cases and the presence of smallpox in other parts of the Republic, and in view of the fear of the population in general that smallpox was already in our midst; all cases of chickenpox were promptly isolated, and wholesale vaccination instituted. Approximately 9,000 men, women and children were vaccinated, with very few serious infections."

DIPHTHERIA.—This disease is comparatively rare in the American Tropics, and the symptoms are usually mild. An interesting article on the subject, by Dr. P. S. Malaret, appears elsewhere in this report.

MUMPS.—Sixty-six, of the 75 cases, occurred in the Honduras Divisions, where the disease is endemic.

ICTERO-HEMORRHAGICA SPIROCHETOSIS.—All 12 cases were recorded by the Colombia Division. (See remarks on "Infectious Jaundice," page 14).

DENGUE.—Only 4 cases were reported; and they were observed in the Colombia Division.

YAWS.—Two cases were recorded by the Colombia Division, and 30 cases by the Cuban Divisions, the latter being confined to Haitians who contracted the disease in Haiti.

It is believed that the statistics for other epidemic, endemic and infectious diseases will be sufficiently self-explanatory, without supplementary comments.

OTHER GENERAL DISEASES

CANCER.—There were 73 hospital cases in 1931—34 employees, and 39 non-employees; with 14 deaths and 10 deaths, of which 13 and 8 respectively occurred in the Hospitals. In addition, there were 5 employees repatriated because they were suffering from this affliction. Vital statistics for employees: morbidity rate, 60 per 100,000; mortality rate (including repatriated cases) 34 per 100,000; fatality rate, 38 per 100 hospital cases. While sufficient data are not available to justify any definite statement, general indications are that cancer is not as prevalent in the agricultural areas where our Company operates as it is in the United States.

BENIGN TUMORS.—There were 56 hospital cases in 1931—35 employees, and 21 non-employees; with 2 deaths and 1 death, of which 0 and 1 respectively occurred in the Hospitals. No features of special importance developed in connection with any of these cases.

BERIBERI.—There were 16 hospital cases in 1931—14 employees and 2 non-employees, with no deaths. The cases were reported by the Colombia Division (4), the Cuban Divisions (3), and the Honduran Divisions (9). In the Reports for 1929 and 1930, there appeared special articles on this subject, in which the symptoms and possible aetiological factors of the cases diagnosed as beriberi in our Hospitals were discussed. The cases observed in 1931 did not exhibit any features which would add to the comments made in those papers.

DIABETES.—There were 16 hospital cases in 1931—4 employees, and 12 non-employees; with 1 death and 2 deaths respectively, all of which occurred in the Hospitals.

OTHER GENERAL DISEASES.—No cases of scurvy, pellagra, nor rickets were recorded; nor were there any other general diseases which were sufficiently prevalent to call for special remarks.

DISEASES OF THE HEART.—There were 199 hospital cases—102 employees and 97 non-employees; with 49 deaths and 36 deaths respectively, of which 38 and 28 occurred in the Hospitals. Vital statistics for employees: morbidity rate, 181 per 100,000; mortality rate, 87 per 100,000; fatality rate, 37 per 100 hospital cases.

BRONCHITIS.—There were 584 hospital cases—381 employees, and 203 non-employees; with 1 death and 9 deaths, of which 0 and 4 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 675 per 100,000; mortality rate, 1.8; fatality rate, nil. The cases were distributed generally throughout all Divisions, with no marked degree of prevalence in any one locality.

BRONCHOPNEUMONIA.—There were 120 hospital cases—40 employees, and 80 non-employees; with 13 deaths and 58 deaths, of which 10 and 36 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 71 per 100,000; mortality rate, 23 per 100,000; fatality rate, 25.0 per 100 hospital cases.

LOBAR PNEUMONIA.—There were 245 hospital cases—165 employees, and 80 non-employees; with 60 deaths and 32 deaths, of which 60 and 29 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 293 per 100,000; mortality rate, 106 per 100,000; fatality rate, 36.4 per 100 hospital cases. Dr. B. M. Phelps, Medical Superintendent of the Truxillo Railroad Company Division, has submitted a paper recording his experiences with this disease; and it appears elsewhere in this Report. A remark made by Dr. J. de la Guardia, Medical Superintendent of the Cuban Divisions, would seem to imply that there is evidence to indicate that there is a certain degree of relative immunity to pneumonia: *"The most notable feature this year has been the marked reduction in the incidence of pneumonia, notwithstanding the poor weather conditions and small epidemics of grippe which occurred throughout the year. Our only explanation is that the Cuban native is much less susceptible to this disease than the Haitian."* In elucidation of Dr. de la Guardia's comment, it may be said that, in 1931, the percentage of Haitian laborers was much lower than in many previous years.

DIARRHEA AND ENTERITIS.—There were 245 hospital cases—140 employees, and 105 non-employees; with 5 deaths and 51 deaths, of which 2 and 7 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 248 per 100,000; mortality rate, 8.9 per 100,000; fatality rate, 1.4 per 100 hospital cases.

ANKYLOSTOMIASIS.—There were 377 hospital cases—269 employees and 108 non-employees; with 1 death of an employee in the Hospital. Vital statistics for employees: morbidity rate, 477 per 100,000; mortality rate, 1.8 per 100,000; fatality rate, 0.4 per 100 hospital cases. An interesting and practical article by Dr. A. Lachner Chacon, of the medical staff of the Compania Bananera de Costa Rica, is published in this Report. Dr. O. T. Brosius, Medical Superintendent of the Panama Division, in calling attention to the large percentage of patients who are infested with hookworms—usually not sufficiently serious to be considered as the primary diagnosis, but a secondary factor of importance because of its debilitating effects and consequent tendency to delay convalescence from malaria, etc.,—states: "*For this condition, as well as for ascariasis, oil of chenopodium still continues to be our standard remedy. This is given in divided doses, without preliminary purges and without dietetic restrictions.*"

APPENDICITIS AND TYPHLITIS.—There were 197 hospital cases—82 employees, and 115 non-employees; with 3 deaths and 3 deaths respectively, all of which occurred in the Hospitals. Vital statistics for employees: morbidity rate, 145 per 100,000; mortality rate, 5.3 per 100,000; fatality rate, 3.7 per 100 hospital cases.

HERNIA.—There were 224 hospital cases—169 employees, and 55 non-employees; with 1 death of an employee treated in the Hospital. Vital statistics for employees: morbidity rate, 300 per 100,000; fatality rate, 1.8 per 100,000; fatality rate, 0.6 per 100 hospital cases.

ACUTE AND CHRONIC NEPHRITIS.—There were 219 hospital cases—139 employees, and 80 non-employees; with 26 and 22 deaths, of which 19 and 14 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 246 per 100,000; mortality rate, 46.1 per 100,000; fatality rate, 13.7 per 100 hospital cases.

CEREBRAL HEMORRHAGE; APOPLEXY.—There were 25 hospital cases—15 employees, and 10 non-employees; with 7 and 7 deaths, of which 7 and 5 respectively occurred in the Hospitals. Vital statistics for employees: morbidity rate, 27 per 100,000; mortality rate, 12.4 per 100,000; fatality rate, 46.7 per 100 hospital cases.

SNAKE-BITES.—There were 50 hospital cases—36 employees, and 14 non-employees; with 1 death among employees and 1 among non-employees, both of which occurred in the Hospitals. Vital statistics for employees: morbidity rate, 64 per 100,000; mortality rate, 1.8 per 100,000; fatality rate, 2.8 per 100 hospital cases.

INFECTIOUS JAUNDICE IN COLOMBIA.—During 1930, a few cases of mild, febrile, jaundiced cases were treated in the Santa Marta Hospital. In September, 1930, a female patient was referred to the Hospital by a local doctor, with a history of six days illness with chills and fever. She was critically ill when she arrived at the Hospital—delirious, restless, intensely jaundiced, and vomiting a yellow material; with a temperature of 102°F., and pulse rate of 140. The next day, the temperature was 103°F.; pulse was 140; and she was vomiting and defecating "black-coffee-ground" material. She gradually sank into a coma, and died at 4 a.m. the following day. At approximately the same time, a male patient with somewhat similar symptoms—continuous temperature for a week, with jaundice and vomiting but with no black vomit, was treated in the Hospital, and recovered.

The two cases mentioned briefly created some alarm; and immediate steps were taken to endeavor to determine the character of the infection and the aetiological and causative factors involved, by enlisting the cooperation of the Rockefeller Institute and of the Gorgas Memorial Laboratory. Specimens of blood and of autopsy material were submitted to the yellow fever Laboratories of the Rockefeller Institute, New York, and the Gorgas Memorial Laboratory, Panama, and exhaustive experiments were made. The Rockefeller Institute, cooperating with the National Department of Hygiene of Colombia and the Department of Hygiene of the Magdalena Province, sent Dr. George H. Ramsey to Santa Marta, in April, 1931; and he remained there for a number of months, investigating the situation thoroughly and extensively with Santa Marta Hospital as a base for his work, and sending numerous specimens of blood obtained from inhabitants of Santa Marta and the adjoining territory north to Dr. W. A. Sawyer, of the Rockefeller Institute in New York, for examination and protection tests.

Local conditions and confusing laboratory results made it difficult to arrive at any definite conclusion, as to whether or not the cases in question were yellow fever. While some of the clinical symptoms were typical of yellow fever, other characteristics did not resemble those usually observed in that disease. Furthermore, while the pathological specimens from the liver of two fatal cases were somewhat typical of yellow fever, and the convalescent sera from some cases were protective to mice and monkeys; the convalescent sera from many other cases were not protective. Moreover, the evidence in the two cases which were pathologically typical of the disease, was not conclusive, inasmuch as both of these individuals were old enough to have had yellow fever years ago when that disease was still prevalent in Colombia; and, among the convalescent sera specimens sent north by Dr. Ramsey, were sera from two cases diagnosed as influenza and splenomegaly respectively, which reported 100% protection—the only possible reason for this being that these two cases must have had yellow fever in the remote past.

Additional factors which obscured the diagnoses were: Leptospira were found frequently in the blood of these patients, by the Santa Marta Hospital laboratory technician; in the few who died and were autopsied, complicating conditions (usually sepsis) were present which would have accounted for the deaths; and examinations made at the Rockefeller Institute in New York revealed that all convalescent sera gave negative results by Pfeiffer test and protection tests with Leptospira icterohaemorrhagiae, while a thick smear specimen obtained from one patient was positive for spirochaetes. Important points to be considered, in eliminating yellow fever as the etiological factor, are: that cases have been appearing sporadically for a period of two years; that the cases have been confined exclusively to the native population, although a large number of non-immunes live in the foreign colony of the same area; and that the disease has not assumed epidemic proportions, after a known existence of almost two years, even in the cities where the stegomyia mosquito index is high.

An interesting side development was reported by Dr. L. M. Drennan, in July, 1931: "*At present most of our cases are coming from the little hamlet of Jamonical, situated twelve miles inland at the foothills of the mountains, where the mule trail to the coffee plantations begins. There have been eight known cases, with four deaths—one occurring in the charity hospital at Santa Marta, and another one here. Dr. Ramsey showed me today spirochetes of relapsing fever in a case with fever from this same place. This at least gives us a most interesting lead—we now know that we have relapsing fever to contend with here, too.*"

An abstract from a report dated January 4th, 1932, rendered by Dr. L. M. Drennan, will serve to summarize the situation up to the end of 1931: "*The number of cases of epidemic jaundice has decreased appreciably. There were about 58 cases in all during the past two years (38 in 1930, and 20 in 1931) with 8 deaths—a mortality rate of 13.8%. No new cases have been admitted nor any reported from the zone for weeks. Owing to a dearth of work all over the country for the past two years, and the possible transmissibility of the disease, it is conjectured that influx of new laboring elements from up-country had a bearing on its appearance here. The causative factor, as previously mentioned, still remains unsolved.*"

While a total of only 58 cases have been treated in Santa Marta Hospital, it is known that other cases have occurred in Santa Marta and the surrounding territory. It is probable, too, in view of the mild symptoms appearing in many individuals, that other cases have developed which did not request hospitalization nor seek the services of a physician and hence remain unrecorded.

The investigation is being continued this year; and, at the present time, The Rockefeller Foundation have assigned Dr. Johannes H. Bauer and Dr. John A. Kerr to pursue the work. Their headquarters are located in Santa Marta; and they are well equipped with laboratory apparatus and experimental animals to conduct extensive and thorough researches by which they hope to eventually determine the exact character of the disease and the causative factor involved. The Colombian Government has appointed Dr. Luis Patino-Camargo to collaborate in these studies, as the Government's representative.

CONCLUSION

When it is taken into consideration that the statistics cover a total population of approximately 133,000, and that the Divisions of the Company are situated in 7 countries and are again subdivided into a much larger number of separate and distinct localities which are frequently adjacent to unsanitated areas, it is apparent that no diseases (excluding malaria, possibly) assumed epidemic proportions or were a serious menace to the welfare of the respective communities, with the exception of those which are endemic throughout the world—e.g., influenza, venereal diseases, and respiratory affections. It may be added, however, that satisfactory health conditions can be maintained only by constant alertness and by unceasing, strenuous effort. All known anti-malarial measures must be applied vigorously at every season of the year; attention must be devoted to sanitation in general, including the repair of quarters, the disposal of human and animal wastes and of garbage, the analysis and treatment of drinking water, and the destruction of harmful insects and of rodents; vigilance must be exercised at all times, with the purpose of discovering the presence of the initial cases of any transmissible or communicable disease in the community and of instituting the necessary measures to cope with the situation before it reaches serious proportions; all available means (meagre, at best, in such localities) of education in hygienic measures must be utilized to the fullest extent; efforts must be made to see that an adequate and well-balanced food supply is provided and consumed—in other words, every phase of hygiene, preventive medicine, and sanitation must be given unremitting attention in a tropical locality of low elevation, if health conditions comparable to those of northern climates are to be maintained.

MALARIA

Malaria is the most prevalent disease in the localities where the United Fruit Company operates, and a constant campaign must be waged to prevent its effects from interfering seriously or fatally with commercial activities and the prosperity of the peoples residing in such areas. Surveys conducted in unsanitated sections of the coastal plains of central American countries indicate clearly that practically all the inhabitants are suffering from malarial infection in either an active or passive stage. Despite the most strenuous efforts and the utilization of all known means of anti-malarial measures, the incidence of malaria can be reduced only to proportions which do not materially handicap the individual or the community; but total eradication of the disease seems to be almost an impossible accomplishment with the present knowledge and conditions. That some progress has been made in the United Fruit Company's Divisions, however, will be evident from the data appearing in Table E.

In Table F appears data showing the relative percentage of various types of malaria, as recorded in the diagnoses of hospital cases.

The ratio of aestivo-autumnal infections to tertian infections, from year to year, is interesting to observe; and particularly in three Divisions—those located on the Atlantic coast of Costa Rica and on the Atlantic coast and the Pacific coast of Panama. The Division on the Pacific coast of Panama (Chiriqui Land Company) was not organized until 1929; and hence the data in the following table G covers only the last three years, for that locality.

Malaria cases diagnosed as "Quartan," "Mixed," "Clinical," and "Cachexia," are disregarded in Table G. Haemoglobinuric fever cases are shown in a separate column, with the purpose of determining whether they increased or decreased in ratio to the prevalence of aestivo-autumnal infections. We are unable to offer any satisfactory explanations for the fluctuations in the relative proportions of aestivo-autumnal and tertian infections; but there does seem to be ample evidence that rainfall is not a determining factor.

TABLE E

Year	Total Hosp. Admissions per 1,000 Employees	Malaria Hosp. Admissions per 1,000 Employees	Percentage Malaria Cases Among Employees to Total Hosp. Cases Among Employees	Percentage Malaria Hosp. Cases to Total Hosp. Cases	Percentage Malaria Disp. Treatments to Total Disp. Treatments	Percentage Malaria Deaths to Total Deaths
1931	322.82	79.02	24.48	22.06	12.30	8.57
1930	355.39	91.51	25.75	22.58	10.29	10.06
1929	375.07	92.96	24.78	22.66	*18.57	9.20
1928	413.96	99.89	24.13	23.28	12.66	7.59
1927	451.87	146.76	32.48	30.67	17.56	12.87
1926	530.65	218.60	41.19	38.89	17.25	15.80
1925	553.12	239.16	43.24	41.23	18.20	14.18
1924	488.30	192.73	39.47	38.18	19.02	12.43
1923	514.27	203.68	39.60	38.04	22.23	13.35
Average for 9 years ending 1922	?	?	?	38.40	23.52	13.64

NOTE.—*The Chiriqui Land Company Division was in a semi-pioneer stage, in 1929; and there was a large influx of laborers from malaria-infected localities. Intensive field and dispensary treatment kept the hospitalization rate remarkably low; but 19,040 Hospital Dispensary Treatments were administered for malaria, as compared with a total of 19,441 in all other Divisions. If we include only those Divisions reporting also in 1928 (i.e., excluding Chiriqui) from this figure; then the percentage would have been 11.61% in 1929 instead of 18.57%. In 1930 and 1931, the labor situation in the Chiriqui Division was much more satisfactory; and consequently the incidence of malaria was reduced to a point which compared very favorably with other localities.

As has been stated previously; the results which have been accomplished have been somewhat gratifying, despite the fact that we are still far from attaining the degree of control which we might desire to accomplish. This is shown by Table H, which gives the number of employees per thousand per annum admitted to our Hospitals for malaria, in those Divisions which have been operated during the years 1925 to 1931, inclusive.

TABLE F

RELATIVE PERCENTAGE OF VARIOUS TYPES OF MALARIA, AS RECORDED IN THE DIAGNOSES OF HOSPITAL CASES

Year	Estivo-Autumnal			Tertian			Quartan			Mixed			Clinical			Cachexia			Hemoglobinuric Fever			Total		
	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases	Percentage of all Malaria Hosp. Cases	Percentage of all Malaria Deaths	Death Rate per 1,000 Cases
1931	60.27	45.06	13.82	17.87	5.49	5.69	.94	.00	.00	2.95	.00	.00	*13.56	8.79	11.99	1.81	4.40	44.94	2.60	36.26	257.81	100.00	100.00	18.50
1930	69.52	41.18	10.83	16.98	2.94	3.17	1.29	.00	.00	4.46	3.92	16.06	4.70	6.86	26.72	.45	2.94	120.00	2.60	42.16	296.55	100.00	100.00	18.29
1929	72.75	56.44	12.86	15.54	5.94	6.33	1.25	.00	.00	3.12	2.97	15.79	4.73	5.94	20.83	1.02	6.93	112.90	1.59	21.78	226.80	100.00	100.00	16.58
1928	61.44	49.21	8.46	21.21	6.35	3.16	1.49	.00	.00	2.10	6.35	32.00	10.90	7.94	7.69	1.48	3.17	22.73	1.38	26.98	207.32	100.00	100.00	10.57
1927	56.29	41.29	10.00	18.74	4.59	3.34	1.18	1.83	21.28	1.50	1.83	16.67	19.54	11.01	7.68	1.00	3.67	50.00	1.75	35.78	278.57	100.00	100.00	13.63
1926	56.93	52.63	11.01	18.61	4.51	2.89	1.57	.75	5.71	1.44	2.26	18.63	18.78	12.78	8.11	1.17	3.01	30.53	1.50	24.06	191.62	100.00	100.00	11.91
1925	55.44	62.16	12.72	21.79	4.73	2.46	.89	1.35	17.24	1.15	2.03	20.00	19.22	8.11	4.79	.74	3.38	51.55	.77	18.24	267.33	100.00	100.00	11.35
1924	39.13	57.14	18.61	31.44	5.72	2.32	.68	.71	13.33	1.21	2.86	30.08	26.07	15.71	7.68	.81	4.29	67.42	.66	13.57	260.27	100.00	100.00	12.74
1923	31.14	43.45	19.21	36.16	11.04	4.20	.61	.00	.00	1.33	2.07	21.43	28.90	20.00	9.53	1.19	11.03	128.00	.67	12.41	253.52	100.00	100.00	13.77
#9 yrs.	27.91	44.16	19.31	27.48	8.26	3.67	.78	.24	3.70	3.16	3.07	11.85	38.40	24.08	7.66	1.74	8.50	59.65	.53	11.69	266.13	100.00	100.00	12.20
Total 18 yrs.	41.17	47.63	14.92	25.25	6.92	3.53	.93	.42	5.93	2.48	2.77	14.41	27.86	17.14	7.93	1.37	6.55	61.72	.94	18.57	253.63	100.00	100.00	12.90

NOTE.—Under each heading, *Col. 1* gives the percentage of all cases of malaria treated in the Hospitals which were recorded under that classification; *Col. 2* gives the percentage of all deaths from malaria among hospital cases which were recorded under that classification; and *Col. 3* gives the number of deaths per thousand cases of each type of infection.

* It will be observed that the percentage of cases diagnosed as "clinical malaria" showed a steady decrease during more recent years, until 1931. In 1931, there was a total of 667 cases diagnosed as "Clinical Malaria;" and, of these, 470 were reported in one Division which recorded more than 35% of their malaria cases as "Clinical." With this exception, the percentage of "Clinical Malaria" reported in 1931 would have been approximately the same as in 1929 and 1930.

#Nine year period from 1914 to 1922, inclusive.

TABLE G

Year	Almirante Division				Chiriqui Division				Costa Rica Division			
	Tertian Cases	E.A. Cases	Percentage of E.A Cases	Hemoglobinuric Fever Cases	Tertian Cases	E.A. Cases	Percentage of E.A. Cases	Hemoglobinuric Fever Cases	Tertian Cases	E.A. Cases	Percentage of E.A. Cases	Hemoglobinuric Fever Cases
1931	6	92	93.88	3	124	89	39.91	13	3	466	99.36	28
1930	3	111	97.31	13	284	276	49.29	27	2	516	99.61	25
1929	17	211	92.54	6	152	375	71.16	16	61	702	92.00	21
1928	21	412	95.15	7					634	499	44.04	22
1927	111	231	67.54	4					653	484	42.57	39
1926	454	62	12.02	4					602	679	53.01	32
1925	808	40	4.72	9					262	367	58.35	17
1924	1,045	34	3.25	9					288	271	48.48	18
1923	981	86	8.06	11					739	173	18.97	15
1922	828	38	4.39	5					811	117	12.61	15
1921	467	15	3.11	9					550	97	14.99	12
1920	324	28	7.95	7					1,068	17	1.57	9
1919	448	43	8.76	7					703	19	2.35	11
1918	193	18	8.53	4					132	12	7.79	11
1917	149	33	18.13	7					177	82	31.66	2
1916	161	28	14.81	6					85	230	73.02	3
1915	135	42	23.73	8					48	255	84.16	7
1914	305	442	59.17	10					65	711	91.62	37

TABLE H

Year	Colombia Division	Costa Rica Division	Guatemala Division	Panama Division	Tela Railroad	Truxillo Railroad	Banes Division	Preston Division	Total Eight Divisions
1925	95.72	156.83	325.14	230.37	184.47	259.46	522.61	242.27	239.16
1926	68.69	259.75	301.05	164.94	158.42	196.46	459.48	134.51	218.60
1927	52.56	222.10	208.78	110.60	199.55	183.28	131.16	100.29	146.76
1928	64.00	147.51	134.91	120.07	113.31	162.05	53.58	37.17	99.89
1929	124.72	95.63	100.78	69.78	119.96	170.02	31.02	18.39	89.34
1930	102.51	67.02	133.68	40.15	110.44	167.03	15.73	12.30	85.43
1931	50.48	62.80	99.70	37.04	89.58	94.41	23.24	15.56	56.69

It will be noted that the rates shown in the above table, for the years 1929, 1930 and 1931, differ somewhat from those recorded in Table E for the corresponding periods. This is due to the fact that the Chiriqui Land Company and the Cortes Development Company Divisions, which began operations in 1929 and 1930 respectively, are omitted from Table H in order to make the data given therein as uniform as possible for comparative purposes. Table E includes all Divisions for which statistics were available in each year—i.e., all Divisions included in Table H are included in Table E, for the years 1923 to 1931 inclusive; and, in addition thereto Table E includes the Chiriqui Land Company for 1929 to 1931 inclusive, and the Cortes Development Company for 1931 only.

A comparison of the malarial and hospitalization rates in 1931, with those for 1926 when our intensive anti-malaria campaign had not been inaugurated, gives an enlightening picture of the results which may be *tentatively* attributed to malaria control measures:

Year	Average Number Employees	Malaria Cases Among Employees	Total Hospital Admissions—Employees	Total Hospital Cases—Employees	Average Hospital Days per Case
1931	44,189	3,492	14,265	182,408	12.78
1926	41,464	9,064	22,003	271,832	12.35
1931	*44,189*	*9,660*	*23,449*	*289,691*	*12.35*

In the horizontal column appearing in italics immediately above, we have indicated the number of malaria cases, hospital admissions, and hospital days among employees, which we would have had in 1931 with an average of 44,189 employees, if the malaria rate and hospitalization rate for employees had been the same as in 1926. Thus, theoretically and tentatively we may assume that our anti-malaria work has resulted in 6,168 less cases of malaria among employees, and in 7,738 less hospital admissions and 107,283 less hospital days for employees. Only the elapse of time will demonstrate conclusively whether other and unrelated factors have contributed materially toward the reduction in morbidity which has occurred; but, it may be added as circumstantial evidence in support of our opinion that the intensive field work is to be primarily credited with the general improvement in health, more or less uniform results have been shown in all Divisions situated in various countries; and the reductions effected have coincided with the efforts expended. Furthermore, that the encouragingly low malaria rate in 1931 can not be attributed to particularly favorable conditions during the year may be readily comprehended when it is noted that the rainfall in the Banes, Preston, Chiriqui, Cortes and Jamaica Divisions was the greatest ever recorded in the history of those Divisions; in Colombia and Tela it was the greatest since 1924; and in the Truxillo Division, it was the heaviest since 1919; while in the Costa Rica, Panama and Guatemala Divisions, it was below the average for the preceding 17 years, although not lower than in several of the more recent years.

GENERAL COMMENTS

The attitude of many of the natives is a constant handicap in our efforts to control malaria. If they are not suffering from the symptoms of malaria in an active and disagreeable form, strenuous objections are registered against the administration of quinine and plasmochin. Adults will frequently refuse to take the drugs prescribed, after fever and other acute symptoms have subsided, and may not permit them to be given to their children. Not infrequently, physical violence is threatened when sanitary inspectors, farm foremen and other employees in charge of labor units, endeavor to persuade laborers and members of their families to take the daily doses of quinine and plasmochin for a sufficiently extended period to effect a cure and to render them non-infectible to mosquitoes. This antagonism seriously interferes with the effectiveness of field surveys, and with the "follow-up" treatment of individuals discharged from the Hospital—and, as a rule, laborers will insist upon being discharged from the Hospital as soon as acute symptoms disappear. However, gradual progress is being made by patient and persistent educative measures.

A few abstracts from the reports received from our Medical Superintendents will serve to illustrate some of the difficulties encountered in sanitation and in malaria-control work in our Divisions:

Dr. J. de la Guardia, Cuban Divisions.—The general health condition in the Divisions has been satisfactory, considering the distressing economic situation, and the fact that *the heaviest rainfall in the history of the Cuban Divisions was recorded.*

Dr. F. C. Watson, Cortes Development Company, Honduras.—This year's work was rendered difficult on account of the occurrence of *the worst floods in the history of the country.* The waters completely inundated the railroad tracks on both the Company and Government lines, on several occasions. All patients from the farms had to be sent to the La Lima Hospital, as it was impossible for them to get to Puerto Cortes. A revolution, rumors of a revolution, and a smallpox scare added to our difficulties. The survey work was stopped six months of the year, on account of revolution, floods and the smallpox scare.

Dr. I. W. McLean, Jamaica Division.—The malaria morbidity amongst the staff has been almost nil, and the morbidity amongst laborers has been much less than in former years, although our rainfall in St. Catherine and Vere was much greater than usual. The rainfall in the Vere District was 67.28 inches for the year, *which is about four times above normal for this area;* and, judging from the incidence of malaria in former years, it would have been impossible to carry on our work there during the past rainy year without the malaria-control measures in operation there. Our malaria-control work in St. Catherine and St. Thomas consists chiefly in quinine and plasmochin medications, keeping the drains in the irrigated district clean and free from debris, camp sanitation, and keeping in repair the screens on the houses of the more intelligent class of employees. Twelve years of systematic attention to healthy conditions, with prompt anti-malarial control measures here, has made our malaria morbidity in these Parishes of no great importance.

Dr. L. M. Drennan, Colombia Division.—The malaria index for the entire division, according to surveys, was 28.5%. This is above the average normal but can be explained by *an unusually heavy rainfall this year* and a much larger camp population in which idlers played a big rôle. Rainfall this year was 74 inches, compared to 29.21 inches last year and 44.01 inches in 1929. In addition to malaria surveys, a spleen index of children under 12 years was taken during May in four of the Company Camps; and 18.5% were found positive for malaria parasites, while 32% had positive spleens. The breeding of Aedes aegypti and Culex mosquitoes in water containers (mainly earthen-ware jars) in and about camps is very prolific. This was observed in a general survey of camps incident to our yellow fever investigations. Culex is by far the most prolific and constant breeder; but many Aedes were also discovered, and bids well for the propagation of yellow fever should it ever gain a foothold. There were 424 cases of malaria treated in the Hospital, as against 960 last year and over 1,100 in 1929. In only three cases was the cause of death recorded as malaria. One was a moribund old man, who was also suspected of epidemic jaundice; one was a case of congenital malaria and syphilis, born in the Hospital; and the third, which was probably genuinely due to malaria, was a child who was in a coma when admitted and was afflicted with a four plus infection.

Dr. E. I. Salisbury, Costa Rica Division.—At one time, 1,300 men, women and children occupied the new Guacimo camp. In the early months of the camp (from January to May) we were blessed with dry weather; and, by prophylactic measures alone, the incidence of malaria was kept very low. Before transportation facilities were available into the farm, the rain began; and, as the whole woodland was felled, there were massive breeding areas around the felled logs and in the tractor ruts. At this time we were using the sand or silt and Paris green mixture; and it was impossible to carry sufficient over the trails to make mosquito control effective. However, after Mr. Hale, the Chief

Sanitary Inspector, substituted the lime-soapstone mixture, the transportation problem was solved and made control work easy except in the pools around fallen trees, etc. These latter mosquito-breeding places were finally cared for by nature, as soon as bananas and second growth shaded the areas. Guacimo (the new camp referred to) sent in 227 cases of malaria to the Hospital, while the remainder of the Division sent only 159—therefore our malaria rate was approximately the same as last year, when it should have been about one-half as high to properly reflect the general improvement of conditions existing in the Division.

Dr. B. M. Phelps, Truxillo Railroad Company, Honduras.—It is of interest to note that 17 per cent. of our hospital days were for malaria, as compared with 23 per cent. in 1930 and a little over 20 per cent. in 1929. Of course, the presence of secondary conditions in malaria cases causes considerable fluctuations in the average number of hospital days per malaria case. In connection with the difficulty experienced by those employees responsible for the treatment of infected individuals at the camps, we quote below a portion of a letter recently received from one of our District Superintendents: "*Medicine for the patients in question was given to the foreman to administer. He reports that adults refused medicine after two doses, and that mothers of the children refused to allow any treaments at all to be administered to them.*"

Dr. O. T. Brosius, Panama Division.—A small influx of Nicaraguan mestizos caused some apprehension lest they increase our malarial index and therewith our morbidity rates, in that this race does not resist malaria as well as do the negroes and mulattoes. Had these not been engaged, our malarial rate would, I believe, have been considerably lower than in 1930.

Dr. B. M. Phelps, Truxillo Railroad Company, Honduras.—Clinical research on the efficacy of "Atebrin" in the treatment of malaria, is considered in a special paper. Many other samples of new drugs or new combinations have been tried, but no striking results have been obtained. I would stress the need of a stable liquid preparation of plasmochin and of "Atebrin" which would facilitate the prescription of the proper dosage for children.

Dr. J. de la Guardia, Cuban Divisions.—In conclusion we might say that the malaria situation in the Division is well under control. Whether we can hope to further reduce its incidence is a moot question. With a high Anopheline index, a heavily infected territory surrounding our divisions, and a continuous migration of people to and from the area, this is certainly doubtful. However, a more determined effort will be made during 1932, and it is with interest that we await the results for that year.

ANTI-MALARIA MEASURES

Those measures which have been deemed most efficacious in the control of malaria are briefly described in the paragraphs which follow immediately. Naturally, the procedure outlined is generalized; and modifications are made in order to cope with local conditions. Some of the peculiar problems encountered in various localities have been mentioned in articles published by the doctors in those Divisions, and have appeared in this and other Reports issued by this Department.

SANITATION.—The features of sanitation which are given primary consideration are:

(1) Selection of sites for labor camps and permanent places of residence. Insofar as possible, sites should be chosen which are at least one mile distant from large bodies of potential or actual mosquito-breeding water; and the area selected should be adaptable to proper drainage and sanitation.

(2) Grass should be kept cut; and all superfluous shrubbery, undergrowth and

other vegetation serving as protection for adult mosquitoes or larvae should be removed, for a distance of 200 to 300 yards from the habitations.

(3) Rain-water barrels, corrals, faucets, pumps, etc., should be constructed and maintained in such a condition that they will not act as nor produce mosquito-breeding bodies of water.

(4) All artificial breeding places should be eliminated; such as empty cans and other discarded containers, collections of garbage and refuse, etc.

(5) All inhabited areas should be inspected weekly, by experienced Sanitary Inspectors; and any body of water which is breeding or might serve to breed mosquitoes should be removed or, if it cannot be removed, treated with Paris green or oil.

Practical phases of sanitation are mentioned, at some length, in papers by several authors which are included in this Report and in the publications for preceding years.

FIELD SURVEYS.—Periodical surveys of all inhabitants are very essential, in order to detect carriers of malaria parasites and institute treatment of all positive cases.

(1) Each labor camp or other unit of residents should be surveyed periodically —preferably at intervals of 3 to 6 months.

(2) During each survey, every effort should be made to obtain specimens of blood from *all* persons in the area which is being surveyed. The specimens should be carefully examined by the thick-film method.

(3) Every individual whose blood is found to be positive for malarial parasites, should be given a course of treatment. For adults, one plasmochin compound tablet and ten grains of quinine should be given twice a day for a period of six days; and the medicine should be administered personally by a responsible person, so that there may be no doubt as to whether or not each individual has taken the prescribed dosage.

(4) When the rate of infection exceeds 25% in a given camp, all inhabitants should be given the routine course of treatment; as it may be assumed that practically every person in the community is harboring malaria parasites if 25% to 50% of the people examined are found to be infected during a survey which involves the examination of only one specimen of blood from each person. Furthermore, such a camp should be subjected to another survey shortly after the blanket treatment is completed; and all persons who are still positive should receive a second course of treatment with plasmochin and quinine. In this manner, the number of carriers should be reduced to a very low percentage; as the cycle of malaria transmission will be broken by the plasmochin rendering the human inhabitants non-infectible to the mosquitoes in the locality, and the majority of cases of malaria will be cured by the quinine administered.

(5) The surveys will give a fair idea of the degree of efficiency of the sanitary measures utilized in the vicinity of the camp surveyed, and will indicate the necessity of intensifying or supplementing such work when the percentage of

infection is high. Moreover, the records of cases of malaria which enter the Hospital or appear at the Hospital Dispensaries, should be carefully scrutinized; as an unusual number of cases from any locality will indicate inadequate sanitation, or laxity in inspection of quarters or in treatment of cases found positive during surveys.

(6) The responsible individual in charge of a camp or labor unit should inspect the quarters daily and exercise other precautions to determine whether or not any cases of illness are present. If a person is found to be ailing, he or she should (a) be given "first-aid" treatment (quinine, if suffering from malaria symptoms); (b) referred to a Field Dispensary, if he has not responded promptly to "first-aid" treatment or is moderately ill; or (c) sent immediately to the Hospital, if he is apparently or obviously afflicted with a serious ailment. Whenever the condition of a case coming to the Hospital indicates that the patient has probably been ill in his lodging for an unreasonable length of time, and that the ailment was more or less obviously of a serious character, an investigation should be made to determine why the man in charge of the labor unit failed to send the patient to the Hospital more promptly.

OTHER PREVENTIVE MEASURES.—Conditions in the localities where the Company operates have necessitated confining anti-malarial measures mainly to sanitation, and to field surveys with treatment of persons found to be positive for malarial parasites. This should not be construed as meaning that we do not recognise the desirable results obtained by screened quarters, destruction of adult mosquitoes by insecticidal agents or other methods, utilization of mosquito bars, whitewashing or applying creosote in the interiors of dwellings, using mosquito repellants, etc. All of these measures are adopted in our Divisions wherever and whenever they can be advantageously employed; but, speaking generally, they are impracticable on our plantations, and hence are not relied upon to any great extent.

MEDICAL TREATMENT

Quinine and plasmochin have been utilized almost exclusively, although preliminary experiments made with Atebrin have given indications that it may prove to be a valuable agent for the treatment of this malady. Brief abstracts from "Malaria—Its Cause, Prevention and Cure"* will serve to outline the methods of treatment which are followed generally:

> "(1) *Primary Infections.*—Investigations have shown that primary infections in individuals otherwise healthy are readily cured if promptly and efficiently treated. When it has been determined by microscopical examination of the blood that malaria infection exists in an individual, prompt administration of quinine in some form and in some way is indicated. Before its administration is begun—except in malignant cases where especially prompt measures are necessary—a preliminary dose of 3 grains of calomel, followed in 6 hours by 1 to 2 ounces of magnesium sulphate, serves a useful purpose and facilitates the cure. A couple of hours after the calomel has been given, the administra-

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* "Malaria—Its Cause, Prevention and Cure"; Deeks, W. E., and Connor, R. C., 1930.

tion of quinine can be initiated. The dose will depend largely on the age, sex and weight of the individual, and also on the nature and the severity of the symptoms. For the average individual with moderately severe symptoms, 30 to 40 grains of quinine daily, divided in 2 or 3 doses, will suffice. This treatment should be continued until the temperature is normal, when a second dose of magnesium sulphate is generally indicated. The quantity of quinine should then be reduced to 20 grains daily divided in 2 or 3 doses, and this dosage should be continued until the patient's temperature has remained normal for from 5 to 7 days.

"Subsequently the patient should be advised to take 10 grains of quinine daily for at least two weeks; or, if anemic, substitute 6 tablets daily of iron, quinine, strychnine and arsenic for the same length of time or longer. A suitable combination for this purpose is the United Fruit Company's Pink Tonic Tablet.

"A generous diet should be ordered as soon as there is a desire for food, and the patient should not be permitted to work before his appetite has returned and he feels physically fit.

"Disease-complicating conditions may delay the convalescence, and should therefore be considered in the treatment.

"(2) *Acute Malignant Cases.*—We often meet with acute cases in which the treatment previously described will not save the life of the patient. Vomiting may be persistent, and the patient unable to retain anything. There may be coma, delirium, convulsions, paralysis, etc., resulting from the localization of the parasites in the small blood-vessels (capillaries) of the brain; or the patient may be unconscious and unable to swallow. In these cases quinine must be administered by means of the hypodermic needle, either intramuscularly or intravenously. The writers have also used the deep-subcutaneous method with gratifying results. By this method the needle should go down to the muscle sheath, but not into the muscles.

"In pernicious cases which present symptoms of coma, convulsions or paralysis, withdrawal of some of the spinal fluid is often a beneficial measure.

"These methods of treatment require professional skill, and should be used only by a physician or a trained nurse.

"The solutions for intramuscular injections should be properly diluted and slowly injected, the location subsequently massaged, and warm applications used to hasten absorption. A solution of excessive acidity will prove very painful and tend to cause destruction of the tissue where it is injected. The preferred sites for injections are the buttocks and beneath the pectoral muscles. It is recommended that the contents of an ampoule should be diluted with 5 to 10 parts of normal saline solution before injection. For intravenous use the dilution should be 1 gram of quinine to from 10 to 20 c.c. of normal saline solution. Some authorities advise a greater dilution up to 100 and even 200 c.c. It is very important, in giving intravenous injections, that the needle be very fine and the injections made very slowly.

"In malignant cases, when either of these methods are used, 15 grains can be given, and be repeated if necessary at intervals of 3 or 4 hours, until 3 or 4 injections have been given. In the case of intramuscular injections it is not wise to give more than 7½ grains in one location, and in subsequent administrations a location should be selected at least 4 inches from the site of the previous injection. The syringe and needle should be sterilized by boiling, and the skin over the site of injection should be thoroughly cleansed and disinfected before the injection is given. These precautions will tend to prevent the development of an abscess. As soon as the patient can tolerate quinine in the stomach, hypodermics should be discontinued and the quinine given by mouth.

"(3) *Chronic and Relapsing Cases.*—In these cases there is a different clinical picture, and treatment must be varied accordingly.

"In the treatment of cases of chronic malaria the complicating conditions must be taken into consideration, and corrected as far as possible. In these cases there is not only blood-destruction but impoverishment of the coloring matter of the red-blood cells, as well.

"An attempt should be made to correct all complicating conditions; and the same malarial treatment recommended for primary infections should be given, with the exception that the quinine, or the combination of it with iron and arsenic, should be continued over 3 or 4 months or until the convalescence of the patient is completely established. In some of the more chronic relapsing cases a change of climate may prove to be very beneficial.

"*Plasmochin.*—The peculiar value of the newly discovered drug Plasmochin lies in its power to devitalize and destroy the sexual forms during some stage of their development and also when they are mature.

"Plasmochin seems to have a specific action on the sexual forms (gametes) of all types of malaria; and when it is administered in a single dose as small as 2 centigrams (gr. $\frac{1}{3}$) to a patient with a rich gamete infection, mosquitoes fed on him for from 4 to 7 successive days fail to develop oocysts (Barber, Komp, and Whitmore). The discovery of this drug forges the last link in the chain of measures necessary to effective malaria control.

"In addition to this peculiar property of plasmochin in devitalizing the sexual forms, some physicians report that it also has a curative effect on the chronic, quinine-resisting cases of benign malaria. Apparently it is without effect on the asexual forms of subtertian or aestivo-autumnal malaria. When given to chronic benign cases for curative purposes, it is recommended that 1 to 3 centigrams ($\frac{1}{6}$–$\frac{1}{2}$ gr.) be given daily for 5 or 6 days, suspended for 3 days and then given again for 5 or 6 days, and always in combination with quinine.

"When plasmochin was first introduced, the manufacturers recommended that from 4 to 6 centigrams be administered daily for 5 days in divided doses, then suspended for 3 or 4 days, and the course of treatment repeated. In this dosage it proves toxic to many patients, producing gastric distress, nausea, vomiting, pallor of the skin, cyanosis, and central liver necrosis with a lethal termination. If the drug is promptly discontinued when the first toxic symptoms appear, recovery generally takes place. In small doses (1 to 3 centigrams daily), the drug is non-toxic and efficacious and can be safely left in the hands of the layman to administer."

ATEBRIN

This drug is prepared by Bayer-Meister-Lucius (I. G. Farbenindustrie Aktiengesellschaft, Leverkusen, Germany); and is marketed in compressed tablets, each tablet containing 0.1 gram of Atebrin. While it was not available commercially in 1931, several of our physicians were provided with sufficient quantities to enable them to conduct experiments on series of cases; and the results they obtained are detailed in separate papers. In most instances, our physicians followed the dosage prescribed by the manufacturers; and administered three tablets or 0.3 gram daily, divided in three doses, for three consecutive days. In a number of cases, however, the drug was given in larger daily doses or for a greater length of time, or both. The tentative conclusions reached may be briefly summarized:

(a) A total of 320 cases were treated with Atebrin—278 aestivo-autumnal, 35 tertian, 1 quartan, and 6 mixed infections.

(b) The dosage recommended by the manufacturers was exceeded in many instances. *Dr. Cordes* (*Preston Division*) states: "*Atebrin was administered as recommended by the manufacturers—viz., three tablets or 0.3 gram daily, divided in three doses, for three consecutive days. In young individuals and those under weight, the daily amount was reduced to 0.2 or 0.1 gram, according to age and body weight. In eighteen cases the treatment was extended to four days, and in 15 cases* *to five days. Only the oral method of medication was used.*" Dr. *Neumann* (*Colombia Division*) states: "*A dosage of 0.3 gm. of Atebrin was given daily, as a rule, over a period of 5 consecutive days.*" *Dr. Phelps* (*Truxillo Division*) states "*In the majority of cases, the drug was given in a single morning dose* (*0.3 gm.*), *with the idea of testing methods of administration which would be convenient in field treatments. Our cases were nearly all treated for from five to seven days.*" Larger doses daily, and more extended periods of treatment, were administered in some instances, without untoward results.

(c) None of the patients under treatment with Atebrin complained of pain in the stomach, dizziness, nausea, nervousness, nor tinnitus, though these symptoms are common with quinine treatment. Treatment with Atebrin is reported to have marked advantages over treatment with quinine, for use in our Divisions —viz., the tablets are small and very soluble; a relatively small number of tablets are required to effect a cure; the toxicity of Atebrin is low, with a wide margin of safety between the effective therapeutic dose and the toxic dose; and it is taken readily by persons who have an idiosyncrasy to quinine or who refuse to take it because of its disagreeable effects.

(d) A rather faint yellowness of the skin may appear in some patients after several days of treatment with Atebrin; but the sclerae were not stained, and no bile pigments were found in the urine. It is more pronounced in the covered parts of the skin. *Dr. Neumann*, who observed 75 cases, states: "*The yellow discoloration of the skin of some of the patients was the only untoward symptom, due to Atebrin, that we noticed. The staining was neither icteric, nor due to anemia; but was a discoloration of the skin similar to that produced by carotin.*" *Dr. Cordes*, who observed 121 cases, states: "*This phenomenon, which we observed once, is not the expression of hemolysis and bilirubinemia* (*as in some Plasmochin cases*); *but is due to the pronounced coloring quality of the drug. Apart from this staining of tissues; Atebrin, in reasonable doses up to 2 or even 3 grams, does not provoke any ill effects.*" *Drs. Phelps and Jantzen*, who treated 124 cases, state: "*Photosensibility does not occur; but a yellow discoloration of the skin may result, and especially if the treatment is extended over 6 days.*"

(e) The results of treatment with Atebrin were uniformly gratifying. The summarized comments of our physicians, in brief, were:

Drs. Cordes and de la Torre: In acute cases with seemingly recent infection, the effect of Atebrin became evident on the second or third day—the temperature fell to normal and general distress was relieved within 48 to 72 hours. We never saw more than two paroxysms with chills and sweating after the initiation of Atebrin treatment. Many cases, most of which were sub-acute or relapsing malaria, were free of fever within the first 24 hours. The curative effect is established on the third or fourth day, in acute febrile cases; and earlier in many of the milder cases—and, within the same period (except in a few instances) all parasites disappear from the peripheral blood. We have not seen one failure in 121 cases—all patients had an uneventful recovery, hemoglobin increased, and spleen tumors generally diminished in size; and there was no difference observed in the effect of the drug on estivo-autumnal and tertian infections. Along with the relief of clinical symptoms, asexual parasites in the peripheral blood diminished and disappeared.

Only the gametes of *Plasmodium falciparum* do not seem to be affected. No follow-up treatment was given except to those cases which developed crescents; and these received pure Plasmochin (0.02 to 0.03 gm. daily) until their blood findings proved negative.

Dr. Neumann: Seventy-five cases of malaria were treated with Atebrin. A dosage of 0.3 gm. of Atebrin was given daily, as a rule, over a period of 5 consecutive days. Atebrin alone cured 16 cases of malaria—clinically as well as protozoologically. An average dose of 6.5 tablets brought the temperature down to normal. The schizonts of E. A. malaria disappeared from the blood stream after an average of 8.2 tablets, and the tertian parasites after 7.6 tablets. Seven cases were examined after periods varying from 1 to 4 weeks; and no relapses were observed nor were any more crescents found. In 59 cases Atebrin was administered in combination with pure plasmochin—0.3 gm. of Atebrin, and 0.03 to 0.06 gm. of pure plasmochin daily, over a period of 5 consecutive days, as a rule. With this combined treatment, the temperature in the 43 cases who had fever on admission became normal after an average dose of 6 tablets of Atebrin. The parasites of tertian malaria disappeared after 5 tablets; while the blood became free from the schizonts of E. A. malaria after an average dosage of 8 tablets of Atebrin. Traces of Atebrin have been detected in the urine as long as 36 days after the last dose was given; and we saw a slight yellow discoloration of the skin lasting as long as 2 weeks after treatment was discontinued—this indicates a slow elimination of the drug, which should commend it for prophylactic use. The treatment of 75 cases of E. A. and tertian malaria has given us the rather spectacular result of curing all the patients within one week or less; and we believe the results obtained in these cases justify its application on a large scale.

Drs. Phelps and Jantzen: There were 124 cases of malaria treated with Atebrin in the Hospital and Hospital clinic. These included both sexes, and children 2½ years of age and over; but were principally adult males. There seemed to be a marked improvement in the general condition of the patient a few hours after the first dose, even though the fever had not abated. Atebrin had no appreciable effect on the size of chronic enlargements of the spleen; but acute splenic enlargements subsided promptly with the improvement of the general condition of the patient. Our experiences indicate that Atebrin, in daily doses of 0.3 gm. for six days, is an efficient therapeutic agent in clearing the blood of the vegetative forms of benign tertian or malignant tertian (E. A.) malaria; and it successfully and promptly relieves the symptoms of malaria. It may be used in smaller doses, but the treatment is more prolonged. Atebrin seems to have no destructive effect on the gametes in the blood; and, for this reason, it should be supplemented with plasmochin.

(f) Relapses were not observed, in the great majority of the cases; although it must be added that local conditions make it impossible to closely observe discharged patients for extended periods of time. *Phelps and Jantzen* (124 cases) stated that, up to February 18, 1932, no relapses had been observed among the patients treated with Atebrin. *Neumann* (75 cases) stated that "*Seven cases were examined after periods varying from 1 to 4 weeks; and no relapses were observed, nor were any more crescents found.*" *Cordes and de la Torre* (121 cases) stated: "*Three patients relapsed after 5, 8 and 12 weeks respectively, with fever and reappearance of parasites—in one of these cases there was the probability of reinfection. Some patients could not be followed up, while others were under observation for too short a period; and consequently the number of relapses cannot be stated in exact figures.*"

(g) Fourteen cases of hemoglobinuric fever, to whom Atebrin was administered, were reported. *Phelps and Jantzen* state: "*Hemoglobinuric fever induced by Atebrin treatment alone was not observed in our series of cases. The evidence is* *deemed insufficient, at present, to state that this may not occur. Five cases of hemoglobinuric fever have been treated during the past few months. All of these patients had taken quinine before admission. They were given different sized doses of Atebrin during the course of their illnesses; and no ill effects from the drug were noted.*" *Cordes and de la Torre* state: "*There were 9 cases of hemoglobinuric fever treated with Atebrin. Atebrin was given in these cases only when parasites were present or reappeared in the blood, which was generally five to six days after the paroxysm; and in all instances the blood became free of parasites after the administration of Atebrin. In no instance did Atebrin provoke another attack of hemoglobinuria. The results in blackwater fever were most gratifying. Our cases, which probably all belonged to the group of quinine hemoglobinuria, could take Atebrin without any ill effects and were cured of their malaria. Atebrin has apparently nothing to do with the intricate mechanism of hemolysis. One may doubt whether the established syndrome of blackwater fever, especially the dangerous anuria, is amenable to any medical treatment. We are, however, always confronted with the necessity of treating the underlying or concomitant malaria. In such cases, as well as in all instances of quinine idiosyncrasy, Atebrin may prove a very welcome agent.*"

The number of cases which have been treated with Atebrin has not been sufficiently large to warrant definite conclusions as to its efficacy nor as to its scope of usefulness. The preliminary experiments give rise to the hope that we have an available agent which will afford valuable assistance in combating a disease which is a constant menace to the health and vitality of a tropical resident.

SUMMARY OF MALARIA TREATMENT.*—(a) Ambulatory cases—i.e., persons harboring malarial parasites, but not exhibiting symptoms of malaria—should be given 1 plasmochin compound tablet and 10 grains of quinine, twice a day, for a period of six days. If parasites are still present subsequent to this medication, the treatment should be repeated. This measure should cure the patient and render him non-infectible to mosquitoes. (b) Cases suffering from mild symptoms of malaria should receive a preliminary dose of 3 grains of calomel, followed in 6 hours by 1 to 2 ounces of magnesium sulphate. Then 30 to 40 grains of quinine should be given daily, divided in 2 or 3 doses. When the temperature becomes normal, a second dose of magnesium sulphate should be administered and the dosage of quinine should be reduced to 20 grains daily (b.i.d. or t.i.d.). This dosage should be continued until the patient's temperature has been normal for from 5 to 7 days; and plasmochin, 2 tablets daily, should be given for 4 to 6 consecutive days during this period to devitalize or destroy the sexual form of parasites. A patient should not be discharged until his blood is free of gametes—otherwise he will serve as a source of infection when he returns to his home or camp, even though he himself is not suffering from symptoms of the disease. (c) Severe cases, of any type or stage of infection, must be treated specifically; although general suggestions are outlined above. (d) Atebrin, in relatively small doses, (3 tablets—0.3 gms. daily, for 3 to 6 days) may prove efficacious to fill the double rôle for which quinine and plasmochin are indicated at present—to cure the patient and to render him non-infectible to mosquitoes respectively; but the experiments have not been sufficiently extensive or complete, as yet, to make any positive assertions to this effect.

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* It must be understood that the measures outlined herein are those which have been found most practicable for general and routine treatment of our employees, who are predominatingly of the laboring classes. These laborers will not submit to extended periods of hospitalization; nor can they be depended upon to take the prescribed medicines after acute and discomforting symptoms have subsided. The medication should be modified for certain individuals and, particularly in chronic cases, quinine should be administered for longer periods when a physician is treating patients who will follow his instructions and advice.

RESULTS OF MALARIA SURVEYS

It is impossible to give a complete review of the findings during the malaria surveys of 1931. In the first place, space will not permit; and, in the second place, the data submitted by the respective Divisions were not sufficiently uniform to even consolidate the statistics in a satisfactory manner. However, a few brief statements will give a general picture of the work done, the findings recorded, and the results accomplished:

(1) A total of 55,803 persons were examined during field surveys. Of these, the blood specimens of 7,713 or 13.8% were found to be positive. The percentages of the various types of infection were:

PERCENTAGE OF VARIOUS TYPES

Divisions		E.A.	Tertian	Quartan	Mixed
Chiriqui		48.5	50.2	0.5	0.7
Colombia		51.0	48.2	0.0	0.8
Cortes		53.6	43.1	2.9	0.5
Costa Rica		94.8	5.2	0.0	0.0
Cuban	Banes	100.0	0.0	0.0	0.0
	Preston	100.0	0.0	0.0	0.0
Guatemala		37.9	49.4	4.1	8.7
Panama		92.8	3.2	3.0	1.0
Tela		56.6	35.1	7.2	1.1
Truxillo		68.8	31.2	0.0	0.0
Total		63.3	33.2	2.1	1.4

(2) Eight Divisions rendered data which showed the relative rate of infection among adult males, adult females, and children, respectively. These data are shown in table on page 32.

Despite the fact that such information was specifically requested, only one Division indicated the age division between adults and children. The Tela Division considered those individuals up to and including 10 years of age as "Children." For the other Divisions, we must assume that the separation of adults and children were not confined to any definite age; but that any individual who had reached a stage of physical development which gave him or her a general appearance of matureness was classified as an adult; while those who had not reached adolescence were grouped as "Children."

Division	Number of Persons Examined				Total Number Positive				Percentage Positive			
	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total
Chiriqui	2582	1197	989	4768	220	76	116	412	8.5	6.3	11.7	8.6
Colombia	836	212	437	1485	198	44	140	382	23.7	20.8	32.0	25.7
Cortes	3058	1240	1179	5477	561	184	237	982	18.4	14.8	20.1	17.9
Costa Rica	2945	1431	1140	5516	244	105	133	482	8.3	7.3	11.7	8.7
Cuban Banes	702	894	1278	2874	10	20	20	50	1.4	2.2	1.6	1.7
Preston	269	317	414	1000	24	35	39	98	8.9	11.0	9.4	9.8
Tela	7446	2640	2379	12465	733	217	199	1149	9.8	8.2	8.4	9.2
Truxillo	5955	3594	3368	12917	1222	676	872	2770	20.5	18.8	25.9	21.4
Total	23793	11525	11184	46502	3212	1357	1756	6325	13.5	11.8	15.7	13.6

(3) The results of surveys of individual camps varied too greatly to permit of any generalizations. In some instances, marked decreases in the rate of infection were recorded during the second and subsequent surveys of 1931, as compared with the initial survey of 1931; in other instances, camps showed noticeable increases in the incidence of infection subsequent to the initial survey; and, in still other instances, the rate increased in the second survey and decreased in the third or fourth survey, or vice versa. In other words, strictly local conditions play an important part in determining the incidence of malaria infection at a given time; and, in order to analyze the situation in a thorough and comprehensive manner it would be necessary to mention each camp or unit individually and to dwell at length on the various factors involved in each case which resulted in an increased or decreased rate at the time of one survey as compared with a preceding or subsequent survey. Influx of new laborers, labor disturbances, floods, unusually long period of drought, close proximity of uncontrollable water areas, adjoining sources of infection not under the supervision of the Company, improper supervision temporarily—these and many other factors are involved, and the distinctive conditions encountered are almost as great as the number of camps.

(4) In one Division a large percentage of the labor camps have been screened, as an experiment to determine the relative value of such a measure. The comparative incidence of infection in the screened and unscreened quarters, as revealed during surveys, were:

	Number Examined	Number Positive	Per cent Positive
Cortes Division—Screened quarters	4,318	718	16.63
Cortes Division—Unscreened quarters	1,159	264	22.78
Total—Cortes Division	5,477	982	17.93
All other Divisions—mostly unscreened quarters	50,326	6731	13.37

While the percentage of infection among inhabitants of screened quarters in the Cortes Division was lower than it was among the occupants of unscreened quarters, it will be observed that the percentage of infection in the screened quarters of the Cortes Division was higher than the average for all other Divisions in which the vast majority of quarters are unscreened. It may be interesting to comment, in this connection, upon the relative number of hospital admissions among salaried employees who mostly reside in screened quarters, and among laborers who mostly occupy unscreened quarters. The following table gives these data for the last six years:

	Hospital Admission Rate for Malaria, per 1,000 Salaried Employees	**Hospital Admission Rate for Malaria, per 1,000 Laborers**
1931	103.17	78.03
1930	156.66	88.64
1929	192.88	88.77
1928	114.30	99.37
1927	136.05	147.52
1926	162.76	221.00

It will be observed that (1) the hospital admission rate for malaria among salaried employees has been uniformly higher than the rate among laborers, since 1927; and (2) that the intensive anti-malaria campaign waged since 1927 has proved especially beneficial to the laboring class, who live principally in unscreened quarters. In analysing these data, it must be emphasized that practically all cases of malaria occurring among the salaried employees are treated in the hospital; whereas a large proportion of the cases occurring among the laborers are not sent to the hospital, but are treated in their quarters.

SECTION II

OBSERVATIONS ON THE DIAGNOSIS AND TREATMENT OF MALARIA*

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In 1910, Sir Ronald Ross published the results of his enumerative studies in malaria. Briefly summarized they are as follows: If blood can be concentrated by spreading it in a thick film, and this film dehemoglobinized and stained, there will be a concentration of about thirty to one in the thick film as compared to the thin smear. As a matter of fact, the concentration in a properly made thick film is about fifty to one. Ross estimated that the lowest limit of the number of parasites required to produce a febrile paroxysm is about fifty per cubic m.m., which in normal blood is one to one hundred thousand erythrocytes. He reckoned that the time required to search one hundred thousand erythrocytes in the ordinary thin film is about one-half hour, and this he gave as the minimum for a careful search in suspected cases. If his figures as to the concentration in the thick film are correct, then parasites should readily be found in this after a search of a minute or less, when they are present in numbers sufficient to cause fever.

Nearly twenty-one years ago at the May, 1911, meeting of this Association I read a paper entitled "Practical Value of the Ross Thick Film Method in the Diagnosis of Malaria." Dr. Henry R. Carter, Jr., and myself had been working on this subject for several months. At that time about 58% of hospital admissions diagnosed as malaria had positive blood findings, and about 42% were diagnosed from the history and symptomology as clinical malaria. We took one hundred consecutive admissions into the old Section F, which was the European labor medical section, to which a large proportion of the malaria cases were admitted. In this series, Dr. Carter and Dr. Deeks diagnosed 63 cases as malaria. These 63 cases showed in the thin film, after Dr. Carter had made a careful one-half hour search, 60% of positive findings. At the same time I examined thick films in all of these cases. The thick films were negative in the 37 cases which were not diagnosed as malaria. In the 63 cases diagnosed as malaria they were positive in all of the 38 cases in which Dr. Carter found parasites, and also in 21 of the 25 cases diagnosed as clinical malaria; so that the percentage of positive findings in cases diagnosed as malaria was raised from 60 to 94%. Further work with these films showed that we sometimes found malaria where we did not suspect it, or as a complication of other diseases. In addition to this, we followed the blood in the positive cases each day when the temperature was over 100°F. In the tertian cases the parasites were found whenever the temperature was over 100°F., and in the E.A. cases the parasites were found as late as three and four days after admission, as long as the fever was over 100°F., although 30 and 40 grains of quinine a day were being administered. The results of our work convinced us that whenever there was fever of over 100°F., due to uncomplicated malaria, we could find parasites without much trouble in the thick film, whether or not quinine had been given; and also that, when parasites were absent in cases with high fever, quinine could be withheld without danger to the patient. In all cases of severe E.A. infection Dr. Carter had no difficulty in finding parasites in the thin film, when quinine had not been given or had been given for only one or two days.

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* NOTE.—This paper was read, by request, before the Medical Association of the Isthmian Canal Zone, February 16th, 1932; and contains only personal experiences. It is not intended as an original scientific contribution.

Unfortunately our technique was rather clumsy, and to stain the thick films for routine work was quite a task. In later years, Barber and Komp have originated a method which is much more simple. Two or three large drops of blood are spread out to about the size of a dime on a clean dry slide, and care must be taken that no grease from thumb or finger prints underlies the film. The film is then thoroughly dried at room temperature and placed in a Giemsa solution for fifteen minutes to one hour, depending on the strength of the Giemsa stain. This mode of examination will give a certain and positive diagnosis in all cases of acute uncomplicated malaria; and in severe cases in which quinine has been given for two or three days previously, it will show parasites, if these are the cause of the fever.

This method is not as yet mentioned in text books on Practice of Medicine, although it is one of the most specific methods of laboratory diagnosis with which I am familiar. In competent hands it is accurate and unerring, and it should be given far more prominence than it has in laboratory manuals and text books as well—especially those devoted to tropical diseases. There are, of course, certain qualifications necessary in making this statement. The examiner must have had experience; he must know how to use the microscope, to obtain the best results; and he must know when the film is properly stained. Before attempting to do thick film work he should make himself familiar with the appearances of the parasites in the thin films, and should check positive thin films against thick films from the same case, until he is satisfied of his ability to determine parasites in the latter. That failure to properly recognize poorly stained films, whether thick or thin, may prove disastrous, is shown by the following case report.

About fifteen years ago, I had a patient under my care in the Hospital de Panama in which my provisional diagnosis was lobar pneumonia. I then had as an assistant a young physician who was supposed to be trained thoroughly in the thin film examination for malaria. He reported negative findings; and I had him repeat the examination, with the same result. My patient became worse; and, at the end of 48 hours, I was alarmed. During this period at least a half dozen blood examinations had been made, all of which were reported as negative for malaria. I next sent for Dr. R. C. Connor, who at that time was Chief of Medical Service in Ancon Hospital. I knew that Dr. Connor invariably made a personal examination of the blood in all febrile cases in which he was in doubt as to the diagnosis. While he was examining the patient, I made another thin film and stained it myself. Much to my chagrin, I found a very severe infection with P. falciparum. Dr. Connor read me a very drastic lecture, which was thoroughly deserved; and the only consolation I had was that he himself had recommended this young physician to me as qualified in the examination of blood for malaria. Fortunately, the films previously made had been preserved. In looking over these, I found that none had been properly stained; and, on re-staining them, there was an abundance of parasites in every one. Only prompt and vigorous treatment saved this patient's life; and since that time I look at the blood myself in all my cases of severe fever, no matter who else examines it nor how much confidence I have in the examiner.

Again, when I was district physician in Ancon, I was called to see a young woman who had every indication of a mild bronchitis; which, as a matter of fact, she did have. In this case I did not examine the blood. About three days later Dr. Olsen, who was then my assistant, was called and found the patient in a state of collapse, due undoubtedly to an internal hemorrhage. Dr. Olsen made an examination of the blood, and found a very mild infection with E.A. malaria. The patient died a very short time after admission to the hospital, and before anything could be done for her.

We obtained a partial autopsy, which was made by Dr. Herbert Clark; and found a small spleen which was almost entirely liquid, and which had ruptured. There was no history of any blow or undue strain. Examination of the smears from the spleen and rib marrow showed only a very moderate infection, but perhaps a life might have been spared had this been picked up earlier.

I am trying to emphasize the importance of the thick film as a positive aid to diagnosis. I can summarize this part of my paper by repeating the statement I made previously—that it is at present one of the most reliable and specific diagnostic tests in all medicine; because, if in competent hands it is negative on two occasions twelve hours apart, then the condition is certainly not acute malaria.

Dr. L. B. Bates informs me that from 1904 to date, there are on record in the Board of Health Laboratory in the Canal Zone 419 cases in which malaria or black water fever were given as the causes of death. Excluding the latter, he is of the opinion that parasites were found invariably, or should have been found, in the peripheral blood before death; and Dr. Herbert Clark confirms this for the period when he was pathologist there.

Since the introduction of the thick film method in the hospitals of the United Fruit Company and in its malaria survey work, there has been an actual and relative increase in the finding of E.A. and quartan malaria while the tertian figures have remained more or less stationary. The increase in E.A. malaria is particularly noticeable, and is largely due to the finding of scanty infections.

In this paper, I am concerned only with the value of the thick film method in diagnosis; and for that reason do not discuss the other concentration and the cultural methods. These undoubtedly have value in chronic malaria and in cachectic states due to different types of the disease; but in my judgment they are not comparable in value with the thick film in diagnosis of malaria, when time is an all important factor.

Within the limits of this paper, it is not possible for me to discuss all the drugs and systems which have been advocated for the treatment of malaria; and I trust you will allow me to devote the rest of my time to comments on methods which I have learned from authorities on this subject and from my own personal experience.

Uncomplicated tertian and quartan infections rarely threaten life; and, however uncomfortable and temporarily ill they make the patient, are easily controlled by even small doses of quinine. Even the heaviest infections in these two types are not comparable in numerical intensity with the number of parasites found in severe and pernicious E.A. malaria. Leaving aside for the present the treatment of tertian and quartan malaria, the first problem in treating E.A. malaria is to judge whether the infection is so severe as to threaten life.

Ross estimates that any E.A. infection of over ten per cent. is nearly always fatal, and this is my experience also. In the pernicious cases in which I have counted the parasites, an infection of between fifteen and twenty and higher was invariably fatal. There is a border line, between five and ten per cent. infections, in which the outlook is always serious; and in these it is the duty of the physician to try to control the infection as quickly as possible. Sometimes there are pernicious cases which are deceptive. There is a temporary remission of the fever, during which period the patient is fairly comfortable for a few hours; but this is also at the time when the largest number of parasites are present in the peripheral blood, and here the heavy infection should be taken as a warning of impending danger. But as a rule, infections of from 5% and upwards are accompanied by great prostration, high fever, and vomiting, so that it is impossible for the patient to retain quinine when given by mouth. Pernicious infections also show many doubly and some trebly infected erythrocytes; and the appearance of these in any quantity should be regarded with grave suspicion.

Secondly, there are cases with prostration, fever and vomiting in which the numerical value of the parasites in the peripheral blood at the time of examination is not high. These call for mature knowledge and prompt judgment in treatment. If the parasites are present in the heavy signet-ring forms, just before they begin to become solid and oval in shape; then this is the time when the greatest number appear in the peripheral blood, and the numerical severity of the infection can be accurately gauged. If only small ring forms are present, it may be that only a small proportion of the parasites are appearing in the peripheral circulation; and here the severity of the symptoms is a valuable guide. Coma is always a grave indication which calls for a reserved prognosis; and is a serious complication.

In the third place, there are those cases with a moderate degree of prostration and a temperature between 101° and 104°F., without vomiting; and the number of parasites in the peripheral blood is only moderate, not exceeding one or two to the microscopical field in the thin film. These can generally be treated with quinine by mouth. It is imprudent to dogmatize on the amount of quinine to be given and on the method of administering it; but I believe that there are certain principles in the treatment which may be generally accepted.

There is a concept in many text books and laboratory manuals that the cycle of the asexual forms is not affected by quinine. This is not true. Quinine has very little effect on mature parasites; but, in sufficient doses, it has a very definite effect on the younger ring forms and the half grown parasites. A very good and accurate account of this is given in Craig's "Parasitic Protozoa of Man."

When the physician is confronted with a case in which there is great prostration, vomiting, delirium, or perhaps coma, and with these a numerically intense infection, or even when these clinical signs are present and a relatively small number only of the very young ring forms are found, then quinine must be given in a manner in which immediate action is assured; and this can be done only by the intravenous method. Personally I prefer to give an intravenous dose of about 1.5 grammes or 22½ grains of quinine in from 100 to 150 c.c. of normal salt solution.

Quinine sometimes has a powerfully depressive action, either on the heart muscle itself or perhaps on the conductivity of the bundle of His; and, if an intravenous injection is given too rapidly, sudden death sometimes occurs. I have seen two instances in which death followed immediately the giving of an intravenous injection by the old Baccelli method, in which ten grains of soluble quinine salt was given from a small 2 or 3 c.c. syringe. But, if the quinine is given slowly in high dilution, the administration can be stopped at the first indication of heart failure; and, as a rule, it can be cautiously resumed later. If the maximum dose of 22½ grains is given, then the physician knows that he has done all that is possible at the moment.

In frank pernicious cases this dose should be repeated every four to six hours, and the blood should be watched carefully to observe the effect. Sometimes a proper vein cannot be found, or for some reason it may not be convenient to give the quinine intravenously. In such cases, as in those in which the infection is not so severe but quinine is not retained by mouth, the intramuscular injections are of great service. When these are given well diluted, in doses of from 15 to 22½ grains of quinine in 10 to 20 c.c. of normal salt solution, absorption is prompt and there is little danger of subsequent abscess formation. I understand that some of the modern ampoule preparations are given without dilution; but I have not had personal experience with this method, as I have preferred to follow one which I know to be reasonably efficient and reliable. The point to remember here is that severe E.A. malaria is always dangerous until the infection is controlled, and delay in the administration of sufficient quinine may result in very serious consequences. These intramuscular injections should be continued every four to six hours, until the physician is satisfied that the danger period has passed.

Theoretically, the intravenous method would be preferable; but at times it is quite difficult to find suitable veins and there is always the fear of a sudden stoppage of the heart, and for that reason I still give intramuscular injections when in my opinion there is no immediate danger from the severity of the infection.

It will be noted that I have advocated the use of large doses of quinine in the treatment of severe and pernicious E.A. malaria. In milder cases of this form, as well as in the treatment of acute tertian and quartan malaria, I believe that large doses should be given promptly also; and should be continued until the fever has subsided. It has been rather definitely shown by Warrington Yorke and S. P. James,[1] that the size of the dose and the amount of quinine given during the febrile period do not have any particular effect in preventing relapses. But in my experience the larger doses do have a very definite action in reducing and cutting short the febrile period in E.A. malaria, and in preventing further paroxysms in tertian and quartan infections. For this reason in all three types I give 20 grains of quinine by mouth as soon as a diagnosis is made, ten grains two hours later, and ten grains more in another two to four hours; followed by 40 grains a day for three or four days in tertian and quartan infections, and until there is no more fever in E.A. malaria. I have long ago abandoned the tapering method of giving quinine. I now give it in doses of ten grains three times a day, for a week after the larger doses have been administered, and then discontinue it. I admit frankly that I do this on the basis of clinical experience.

S. P. James, Warrington Yorke, and other English workers have shown that about the time of the third and fourth relapse in tertian and quartan malaria, which usually comes on from the sixth to the ninth month after the initial attack, most cases are radically cured by the administration of relatively small doses of quinine.

Some very interesting work has been done by Ramsden[2] and his associates, at the Liverpool School of Tropical Medicine, on the estimation of quinine in the animal tissues and liquids. They have shown that a large proportion is metabolized in the body without being concentrated in the blood. They state that the quinine introduced into an animal in large doses accumulates in most of the tissues with very much higher concentration than in the blood, and of the quinine present in the blood, more than three-fourths is in the serum; and that normal red blood corpuscles take up very little quinine. They further state that about 90% of quinine injected intravenously disappears from the blood within one minute. Also, when it is administered in a succession of large doses; an abnormally large proportion, from 90 to 93% of that ingested, is metabolized. They also show that no concentration of quinine in the blood, which is at all likely to be compatible with the continued existence of the host, can be counted on to effect a radical cure; but whether a certain minimum percentage of quinine in the blood may be necessary to cut short a particular attack of malaria is another question. They found that the concentration of quinine in the blood showed marked variations in different persons.

If there is a paradox between clinical results and laboratory findings, as far as the practice of medicine is concerned, the burden of proof rests upon the laboratory worker. We tried the effects of different doses of quinine for many years, and found that as a matter of clinical experience the larger doses were much more efficacious in cutting short the febrile periods; and I believe this is also the experience of most physicians who have treated large numbers of severe E.A. infections, and it is certainly true for tertian and quartan fevers. The great Confederate cavalry leader, General Nathan Bedford Forrest, was asked once why, with so inferior a force, he consistently and over a long period made things very unpleasant for the enemy. He replied that his aim was "To git thar fustest with the mostest men." I believe that, in the treatment of malaria, it is very important to attack early with plenty of quinine; and I justify this statement by clinical experience.

I am aware that, in this paper, I have covered the subject very incompletely; and I do not ask you to accept my findings as conclusive. I have had, of necessity, to leave out much evidence which might support them; and, through lack of time, have been unable to present the arguments of those who are not in agreement with my opinions. For this reason I have omitted any discussion of plasmochin, except that I shall state I am frankly skeptical of many of the claims made for that drug. I have tried to show that acute malaria should be diagnosed, in every instance, under proper conditions of examination of the blood; that time should not be lost when the physician is confronted with the pernicious type, or with an infection which may become pernicious; and that, in my opinion, the febrile stage of the disease is best treated with relatively large doses of quinine. I do not believe that much of value in the diagnosis of acute malaria can be added to our present knowledge except perhaps a complement fixation test, and that takes time; but I am quite convinced that many of our ideas of therapeutic prophylaxis, and of treatment, may have to undergo a thorough revision in the light of the experimental work which has been done in the last fifteen years. Fifteen years ago I could have agreed cheerfully that I had learned about all there was to know concerning malaria; while I am of a very different mind today. But in the presence of acute malaria, as physicians, it is our duty first to try to cure the patient and later to do our speculating.

SUMMARY

(1) The thick film offers in competent hands a positive and rapid diagnosis in all cases of acute uncomplicated malaria, whether or not quinine has been given for two or three days previously.

(2) In pernicious malaria, as determined by the severity of the symptoms or the numerical value of the parasites in the blood, quinine should be given intravenously.

(3) In less severe cases, when quinine cannot be retained by mouth, it should be given intramuscularly. Personally I prefer to dilute it, but I understand that ill results do not follow the injection of some of the modern soluble preparations. Subcutaneous injections should be avoided.

(4) In treating malaria with quinine by mouth I believe that large doses, as above described, are more efficacious in cutting short subsequent fever and paroxyms, than are smaller ones, although their value in preventing relapse is at this time undetermined.

REFERENCES

(1) See review of Colonel S. P. James' publication, in the Annual Report for 1930.

(2) Ramsden, W., Lipkin, I. J., and Whitley, E.—(a) *Detection and Estimation of Quinine in Blood and Urine*, Annals Trop. Med. and Paras., Vol. XI, No. 4, May, 1918, and (b) *On Quinine in Animal Tissues and Liquids, with Methods for its Estimation. Ibid.*

OBSERVATIONS ON MALARIA INCIDENCE IN SOME UNSANITATED RIVER VILLAGES IN THE REPUBLIC OF PANAMA, WITH SPECIAL REFERENCE TO PROPOSED CONSTRUCTION PROJECTS IN THE CANAL ZONE*

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Ancon, Canal Zone

The methods usually applied in the control of malaria consist in permanent drainage or routine treatment of anopheline mosquito breeding areas, screening of living quarters, and the hospital and dispensary treatment of malaria for those who seek such medical care. Measures in malaria control seldom include the treatment of that vast number of rural people who really form most of the seed bed of malaria and perpetuate the risks of transfer to contacts living under better

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circumstances. Usually people who pass their lives in these rural areas show a comparatively high tolerance to the disease and they are not therefore prone to follow a complete, vigorous course of treatment that would in many cases eradicate it. We are interested in studying and stimulating control measures directed at this seed bed of malaria. It is fully realized that this branch of malaria control is expensive, but it should be attacked with the same vigor, use of funds and personnel that mosquito control receives. The screening or mosquito-proofing of quarters, mosquito control, and efforts toward eradication of the infection in human carriers should proceed together and with equal emphasis if circumstances permit. Unfortunately financial circumstances and other conditions frequently make this ideal impossible.

The Panama Canal Zone, in its strictly sanitated area, has for years presented excellent evidence of what can be done in malaria control by the use of screened quarters and mosquito breeding control. Rural labor units sent outside the sanitated zone for duty also receive unusually good protection if the individual will take full advantage of the opportunities provided. Here, however, trouble develops. Most rural units are well protected during the working period of the week, but they spend the week-end too frequently outside protected or sanitated areas. It is the rural organization in contact with uncontrolled malaria seed beds that excites interest. We have had the good fortune during the past year to assist the Health Office of the Panama Canal in studying the malaria parasite index in rural inhabitants outside the sanitated zone and also to perform monthly blood film surveys on workers engaged in the road building and in the preliminary construction work on the Madden Dam, which will be located in the mid-basin of the Chagres River.

It is morally certain that a large fraction of the labor force to be used in the building of the Madden Dam during the next few years will not be satisfied to live in the protected camps provided for them, since there are too many small rural villages near by in which they can provide themselves with their own quarters and live with their families. We have selected for our present topic of discussion five of these villages. They lie just inside the Republic of Panama on the banks of the Chagres River with one exception, and this village is a short distance away on the bank of the Gatuncillo River, which is a branch of the Chagres. Many of the men now engaged in the preliminary work at Madden Dam go home each night in their own little river boats. No doubt these villages will be greatly increased in population during the years in which this project will be developed. It takes the men in the remote villages about an hour in their boats to reach their work. These villages are populated at present very largely by river folk that have had little contact with the outside world. Until recently they had no local medical or sanitary help. They depended on river water for all household uses and had no latrines or pit closets. The vast majority of the houses have a thatched roof, cane walls and dirt floor, and nearly all of the houses are quite near the river bank. These people cultivate small farms, and most of these are from one to two days' river travel upstream from their village. This means that they divide their time between their home villages and farm houses, this making it extremely difficult to follow a regular schedule of treatment or survey work. Vast potential breeding areas for mosquitoes are all about these locations in the form of grassy river banks, river bayous or lagoons and small collateral brooks that run through the villages. These five villages provide an excellent, unmolested rural river location for the study of malarial problems. We began our observations in these places in cooperation with the Republic of Panama and the Panama Canal so that our work might have some practical bearing as well as laboratory value. We hoped that one year's experience would direct us in formulating future plans in these locations in contact with the development of the Madden Dam.

We had expected during the year to pursue routine observations on the following points:

(1) Mosquito density in quarters.

(2) Mosquito breeding areas.

(3) Primary survey for the malaria parasite index, spleen index and hemoglobin index.

(4) Provide the villages with a community nurse, free quinine and voluntary administration of the drug.

(5) Monthly surveys for the malaria parasite index for a year under voluntary quinine administration.

(6) Record the character of cooperation of the inhabitants.

(7) Study the babies with regard to the age at which they acquired malaria and thus provide some information on exposure to new infection in such places.

(8) Note the rate of gamete carriers in relation to gamete carriers that might be considered good mosquito infectors.

(9) Note the number of heavy infections found that are of the usual hospital intensity type.

(10) Note house and individual incidence during the year.

A detailed monthly report on mosquitoes caught in quarters and in traps and the routine searches of potential breeding areas for mosquito larvae cannot be given for the year due to conditions and interruptions we could not control. However, the anopheline flights and catches in quarters during the first six months of this period were not so extensive as we anticipated and not so extensive as the low inhabited sea coast plains exhibit.

Sampling of the huge river bayous revealed very little evidence of anopheline mosquito breeding, although the small brooks and pools behind the villages show such breeding except in the dry season months.

Primary Survey of Inhabitants.—The initial examinations were conducted in two villages (New San Juan and Gatuncillo) in December, 1929, while Santa Rosa, Guayabalito and Las Guacas were examined in September, 1929. We examined once, by the thick film method, 260 children (15 years old or less) and found 147 of them positive, or a rate of 56.6 per cent; 339 adults revealed 126 cases, or a rate of 37.2 per cent. The total parasite rate was 45.6 per cent and the total spleen rate was 21.8 per cent.

These people are strongly negroid in type and do not show the degree of splenic enlargement commonly found. Only sixteen of them had spleens that extended more than two fingers below the costal margin. Of the 273 individuals positive for malaria parasites, only 48, or 17.5 per cent, were of the hospital intensity type. There were 160 cases of *P. falciparum* infections and 51 of them showed crescents, but only 8 of them in such abundance that they would be considered good mosquito infectors.

The hemoglobin index was taken by the Tallquist method on 508 of the inhabitants and 153 (30.1 per cent) ranged between 30 and 60 per cent, while the remainder, 355 (69.9 per cent) scaled between 70 and 80 per cent.

Treatment.—Compulsory quinine treatment was in effect at the Madden Dam screened labor camps and with this as a yard stick we instituted in the contact villages voluntary free quinine treatment under the direction of a community nurse, who was given assistance by school teachers in three villages and by the corregidors in the other villages. After each survey, the list of those positive for malaria was given to the nurse, and each adult case was supplied with enough of the drug to carry out a ten day course of treatment of 20 grains a day, while children received a graded dose of the drug, according to size, for the same period of time. Anyone who developed fever between the periods of survey was supplied with quinine, and second day visits were made by the nurse to encourage those with malaria to keep up their treatment. During the school period of the year we had the cooperation of the teachers in carrying on the treatment of children. Our surveys were conducted once a month, starting with September, 1930, and ending with August, 1931. The results are tabulated below.

CONSOLIDATED REPORT ON THE FIVE VILLAGES BY MONTHS

(Adults and Children Combined)

Date	Number Examined	Number Cases Malaria	Malaria Parasite Index	Rainfall in Inches Alhajuela (Madden Dam)
September, 1930	289	47	16.2	12.63
October, 1930	339	53	15.6	10.15
November, 1930	290	58	20.0	3.08
December, 1930	300	81	27.0	0.88
January, 1931	433	93	21.5	0.24
February, 1931	398	82	20.6	0.13
March, 1931	513	80	15.6	2.35
April, 1931	529	112	21.1	2.19
May, 1931	463	123	26.5	11.08
June, 1931	398	106	26.6	13.72
July, 1931	425	86	20.2	12.81
August, 1931	420	116	27.8	9.06
Twelve months totals	4797	1037	21.6	78.32

The mean temperature record for the Pacific Section of the Canal Zone for the year 1930 was 87.8 degrees, and for the Atlantic Section 86.3 degrees. Since the Chagres River locations are midway between the two oceans and are only fifteen feet above the surface of Gatun Lake, it may be taken for granted that the temperature is about the same as those recorded for the Balboa Heights and Cristobal stations. Note the wide variation in the number presenting themselves for examination at each survey. School periods, planting and harvesting time have something to do with these variations.

The parasite index for each month does not parallel the monthly rainfall, since it is fairly steady throughout the year.

The following tables will compare the parasite rates of the initial surveys when no treatment was available with the average monthly parasite rate during the year when voluntary free quinine treatment was in effect.

NEW SAN JUAN

(On banks of the Gatuncillo)

Children vs. Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment	88	52	59.1
Av. of 12 surveys for children. Voluntary treatment	71	16	22.5
Primary survey adults. No treatment	141	43	30.5
Av. of 12 surveys for adults. Voluntary treatment	61	8	13.1

GATUNCILLO

(At the junction of the Chagres and Gatuncillo Rivers)

Primary survey children. No treatment	34	14	41.1
Av. of 12 surveys of children. Voluntary treatment	28	9	32.1
Primary survey adults. No treatment	26	4	15.3
Av. of 12 surveys of adults. Voluntary treatment	24	5	21.0

GUAYABALITO

(On the banks of the Chagres)

Primary survey children. No treatment	52	32	55.1
Av. 12 surveys of children. Voluntary treatment	49	13	26.5
Primary survey adults. No treatment	58	27	46.5
Av. of 12 surveys adults. Voluntary treatment	32	7	21.9

SANTA ROSA

(On the banks of the Chagres)

Primary survey children. No treatment	63	38	60.3
Av. of 12 surveys of children. Voluntary treatment	61	16	26.2
Primary survey adults. No treatment	84	39	46.4
Av. of 12 surveys of adults. Voluntary treatment	36	5	13.9

LAS GUACAS

(On the banks of the Chagres. Almost surrounded by water)

Children vs. Adults	Number Examined	Number Positive Malaria	The Malaria Rate
Primary survey children. No treatment . .	23	11	47.8
Av. of 12 surveys children. Voluntary treatment	17	4	23.5
Primary survey of adults. No treatment . .	30	13	43.3
Av. of 12 surveys adults. Voluntary treatment	20	3	15.0

CONSOLIDATED VILLAGES

Primary Surveys. No treatment in use

Children	260	147	56.5
Adults	339	126	37.2
Totals	599	273	45.6

CONSOLIDATED VILLAGES

Average of 12 Monthly Surveys. Treatment in use

Children	226	58	25.6
Adults	173	28	16.2
Totals	399	86	21.6

The following table shows the effect of screened camp quarters and the compulsory use of quinine for those positive for malaria. These labor units are located in the same general area as the villages.

RURAL LABOR UNITS

The Panama Canal

Av. of 6 Thatcher Highway Surveys Av. of 14 Madden Dam Surveys	Number Examined	Number Positive Malaria	The Malaria Rate
Thatcher Highway forces	244	9	3.7
Madden Dam and road forces	272	14	5.1
Totals	516	23	4.4

SPECIES MALARIA PARASITES

(Found in 12 Village Surveys)

Date	P. falciparum	P. vivax	P. malariae	Mixed	Total
September, 1930	18	23	2	4	47
October, 1930	25	23	5	0	53
November, 1930	37	13	8	0	58
December, 1930	36	42	2	1	81
January, 1931	42	41	9	1	93
February, 1931	64	17	1	0	32
March, 1931.	54	21	3	2	80
April, 1931	80	18	11	3	112
May, 1931	97	20	4	2	123
June, 1931	83	18	5	0	106
July, 1931.	73	8	5	0	86
August, 1931	92	20	4	0	116
Total	701	264	59	13	1037

This shows an incidence of species as follows:

P. falciparum	67.6 per cent
P. vivax	25.4 per cent
P. malariae	5.7 per cent
Mixed	1.2 per cent

We have established the gamete rate on the species *P. falciparum,* since the gamete of this species is more easily and surely detected by the various technicians, and it is our most common form of malaria.

INCIDENCE OF P. FALCIPARUM CRESCENTS

Monthly Surveys

Date	P. falciparum Cases	Number of Crescent Carriers	Monthly Rate of Crescent Carriers	Good Infector Types of Crescent Carriers
September, 1930	22	10	45.4	5
October, 1930	25	10	40.0	6
November, 1930	37	4	10.8	3
December, 1930	37	2	5.4	2
January, 1931	43	6	13.9	4
February, 1931	64	14	21.8	9
March, 1931	56	23	41.0	9
April, 1931	83	24	28.9	7
May, 1931	99	21	21.2	6
June, 1931	83	14	16.8	4
July, 1931	73	14	19.1	2
August, 1931	92	22	23.9	8
Total	714	164	22.9	65 (39.6%)
Primary survey	160	51	31.8	8 (15.7%)

INCIDENCE OF MALARIAL INFECTIONS OF HOSPITAL INTENSITY TYPE

Date	Las Guacas	Santa Rosa	Guay-abalito	Gatun-cillo	New San Juan	Totals
September, 1930	1	4	0	2	1	8
October, 1930	0	6	0	4	4	14
November, 1930	0	3	4	3	3	13
December, 1930	0	1	0	1	1	3
January, 1931	2	3	3	2	6	16
February, 1931	1	0	2	0	5	8
March, 1931	0	5	1	5	5	16
April, 1931	0	5	7	5	9	26
May, 1931	0	7	5	1	5	18
June, 1931	2	6	3	2	8	21
July, 1931	1	4	0	2	6	13
August, 1931	1	3	6	3	4	17
Totals	8	47	31	30	57	173

These cases were not sent to any hospitals or dispensaries for treatment, but they represent the intensity of infection that usually does require hospitalization. These people have a decided negroid blend and their tolerance is high. It very seldom happens that anyone dies as a result of a malarial attack in these villages, but they are below par for any sustained daily physical effort, and form a seed bed for the propagation of the disease.

The twelve monthly blood film surveys revealed 1,037 persons that were positive for malaria parasites, and 173 of them, or 16.6 per cent, were of the type usually requiring treatment in a hospital. The initial survey of the five villages yielded 273 persons showing parasites, 48 of them with severe infections, or 17.5 per cent.

It is impossible for us to know how many of these cases of malaria found in field surveys are newly acquired infections, and how many represent relapse. We certainly feel that relapse forms the bulk of each village index. In order to gain a little light on the question of exposure in such locations and the period of time the average individual might live in such surroundings before acquiring malaria, we have made it a rule to examine all babies. We have collected our records on the babies examined in these five villages and in several other locations similar to them. The results are tabulated below.

BABY SURVEY

Rural Villages and Farm Houses

Ages	Number Examined	Number Positive for Malaria
1 month or less	6	0
1 to 2 months	7	0
2 to 3 months	13	3
3 to 4 months	16	3
4 to 5 months	7	0
5 to 6 months	11	5
6 to 7 months	17	5
7 to 8 months	16	2
8 to 9 months	9	6
9 to 10 months	11	0
10 to 11 months	12	6
11 to 12 months	95	20
Total	220	50

During the first six months of life the parasite index was 18.3 per cent, and in the second six months it was 24.4 per cent. No parasites were found in the thirteen babies that were two months or less of age.

The 50 out of 220 babies gives a parasite rate of 22.7 per cent, and that is about what the average consolidated village rate is for total inhabitants.

SPECIES OF PARASITES FOUND IN THE BABIES

Species of Parasite	Number of Cases	Species Incidence	Species Incidenc in Total Inhabitants of the Five Villages
P. falciparum	33	66.0	67.6
P. vivax	15	30.0	25.4
P. malariae	1	2.0	5.7
Mixed infection	1	2.0	1.2

MALARIA RATES IN PERMANENT INHABITANTS

During the course of the monthly surveys, many individuals were examined only once, being casuals in the town—friends or relatives of the inhabitants. These casuals swelled the total numbers of those surveyed and contributed their portion to the malaria rate. To offset any influence they may have had, and to determine the effect of house location and other factors on "family malaria," another compilation of the individuals and rates in the surveys was made, using as a base an official census made in May, 1931, during a hookworm campaign. In this census all houses, with their occupants, were enumerated in each town. From these records it was possible to discover the place of residence and the relationships of the inhabitants. The results for the five towns show the difficulties in the way of any treatment campaign which may be instituted in the future. In all, 772 persons listed in the census were examined at least once during the course of the surveys. Of these, 417, or 54.0 per cent, showed the presence of malaria. That this is not the true incidence of the disease is shown by the percentage positive found in those examined 8 to 13 times. There were 181 individuals so examined, of whom 153, or 84.5 per cent, were positive. Very few persons were examined 12 successive times at monthly intervals; 32 so examined showed 27 positive, or 84.4 per cent. Of those 13 persons examined in the original survey and at every successive survey, 12, or 92.3 per cent, were positive. No doubt this per cent could be increased by greater frequency or by longer periods of examination. That the rate of 54.0 per cent found in the surveys was too low is shown by the fact that over two-thirds of those surveyed (68.0 per cent) were examined 6 times or less. Fifty per cent were examined 4 times or less. An interesting relation between number of persons and of malaria cases in a house is present. Thus, in Guayabalito only a quarter of those who live by themselves have malaria, while of those living in dwellings housing seven persons, 85.7 per cent have malaria. This is no doubt in part explained by the fact that those living alone are older persons, while the large families contain many children, whose rate is always high. It is impossible to give the exact average age of those living alone, to compare with the age of the adults living with large families, but five of six adults who lived with large families had malaria, while only two of eight living alone contracted the disease. An important factor bearing on this phase is the increased attraction for Anopheles of a house full of small children, as against the small attraction of a single inhabitant.

RELATIONS OF NUMBER OF PERSONS IN HOUSE AND NUMBER OF CASES OF MALARIA IN EACH HOUSE

Guayabalito

Number in house	1	2	3	4	5	6	7
Number of houses	8	6	9	7	8	2	3
Possible cases of malaria	8	12	27	28	40	12	21
Number actually positive	2	6	18	16	29	2	18
Percentage having malaria	25.0	50.0	66.6	57.0	72.5	16.6	85.7

Las Guacas

Number in house	1	2	3	4	5	6
Number of houses	8	7	6	2	3	1
Possible cases of malaria	8	14	18	8	15	6
Number actually positive	3	6	10	6	7	5
Percentage having malaria	37.5	43.0	55.5	75.0	46.6	83.3

Because of incomplete data it was impossible to tabulate similar information for the remaining three towns.

SUMMARY

(1) Five primitive river bank villages located in the mid-basin of the Chagres have been observed for one year. Thick blood film surveys were conducted once each month. Those found positive were placed on voluntary treatment with free quinine and others who desired quinine between surveys were supplied. The average of 12 monthly surveys shows a reduction of the parasite rate to one-half its primary incidence.

(2) The cooperation of these people, unaccustomed to public health discipline, was far better than we could have expected, although it was by no means all that is required to gain the full benefit of field treatment against the malaria seed bed. Mass treatment under thorough discipline is necessary to bring the parasite index anywhere near the rate of the adults in the screened labor camps of the Panama Canal, a short distance up the river from the villages.

(3) Anopheline mosquito density, in spite of the vast potential breeding areas near by, is not so great as in the inhabited sea coast plains. The Madden Dam will be completed in a few years, and only a small operating personnel will live at the site. Extensive permanent anti-mosquito operations about these contact river villages are therefore not indicated. Screening or mosquito-proofing the native house, as a general measure, will not meet with the approval of these river folk. It therefore becomes an area of great interest if thorough mass treatment can be inaugurated during the coming year with quinine and plasmochin.

(4) Examination of babies during the year showed no positives until the third month of life, but the general rate up to 12 months of age was about the same as the combined rates for the villages. Successive monthly surveys for a year on the other inhabitants indicate that nearly all of them reveal parasites at some time during the year. New infections therefore appear to play a less important rôle in maintaining the village index than relapse.

(5) Carriers harboring sufficient gametocytes to be good infectors for the mosquito are rare. The incidence of this type of carrier among those who revealed estivo-autumnal crescents was 15.7 per cent before voluntary quinine started, and during the period of treatment it was 39.6 per cent.

(6) Severe infections were not very infrequent, but none of them desired to have hospital treatment, and their stay in quarters was very brief.

(7) The monthly incidence of malaria as revealed by the blood film survey showed almost no tendency to follow the curve in rainfall.

(8) The house or family incidence of malaria appears to depend more on the number and character of the people in a given house than upon the character and location of the house. A large family will form a greater attraction for the Anopheles mosquito than a single individual in a house.

Seven hundred and seventy-two permanent inhabitants of the five river villages examined at least once each gave a rate of 54.0 per cent. One hundred and eighty-one permanent inhabitants examined at least eight times gave a rate of 92.3 per cent, showing that presumably the entire population at one time or another during its lifetime becomes infected with malaria.

FIRST EXPERIENCES WITH ATEBRIN, A NEW ANTIMALARICUM

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United Fruit Company Hospital

Preston, Cuba

From September, 1931, to January, 1932, a new product now named Atebrin (originally called Erion) was tried out on malaria cases in Preston Hospital and Guaro Dispensary.

Atebrin is synthetically composed by Bayer-Meister-Lucius, Germany, along the principles of modern chemotherapy. Experiments on bird malaria proved its highly curative and protective qualities; and, at the same time, demonstrated that there was a wide range between the effective and the toxic doses. Preliminary experiments on paralytic patients artificially infected with malaria were also satisfactory.

Atebrin is a powder of intense yellow color which is readily soluble in water with fluorescence. Its reaction is neutral. It passes through the organism without decomposition; and can be demonstrated in urine and fecal matter by a simple test. The excretion is slow, probably extending over several weeks. For oral medication it is combined with an inert substance and compressed in tablet form, each tablet containing 0.1 gram of Atebrin. It can also be administered by intramuscular and intravenous injection.

Our experience with Atebrin covers 121 cases of malaria, 58 of which were treated in Preston Hospital and 63 in Guaro Dispensary. This number includes white and colored people, and adults and children of both sexes and various ages. Infants were not subjected to treatment, because of the uncertainty concerning dosage. Hospital cases received the routine care; temperature was recorded four times daily during the febrile stage, and twice daily subsequently.

The blood was examined every morning for malaria parasites; and the hemoglobin was checked at definite intervals. Dispensary patients were seen every day during treatment; and a thick blood film was taken before and after Atebrin medication. As far as it was possible to do so, the cases were observed for weeks and even months, with periodical clinical and blood examinations to determine the occurrence of relapses.

Atebrin was administered as recommended by the manufacturers—viz., three tablets or 0.3 gram daily, divided in three doses, for three consecutive days. In young individuals and those under-weight, the daily amount was reduced to 0.2 or 0.1 gram, according to age and body weight. In 18 cases the treatment was extended to four days, and in 15 cases to five days. These included those cases in which ring forms or rise of temperature persisted after three days of treatment. Only the oral method of medication was used. No "follow-up" treatment was given except to those cases which developed crescents; and these received pure Plasmochin (0.02 to 0.03 gram daily) until their blood findings proved negative.

J.A., MALE, HAITIAN, COLORED, 56 YRS.

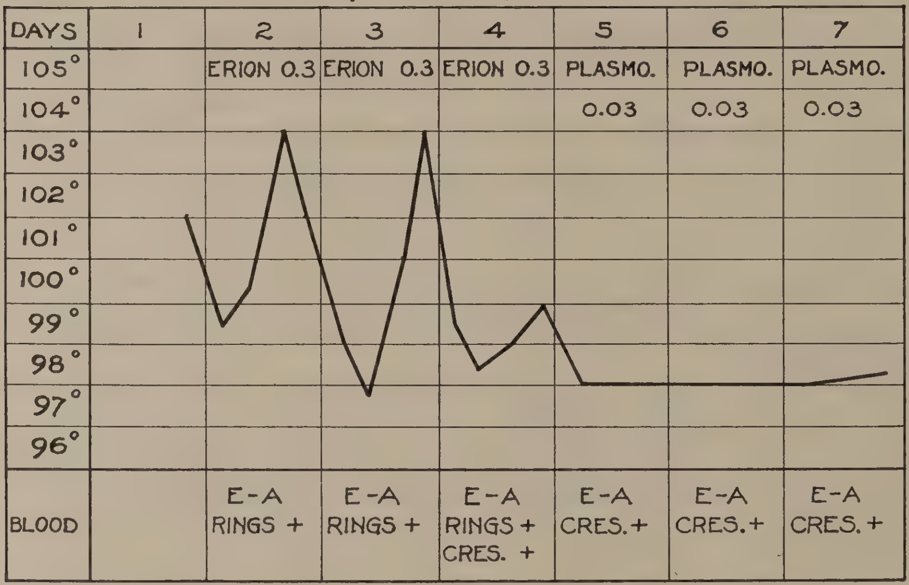
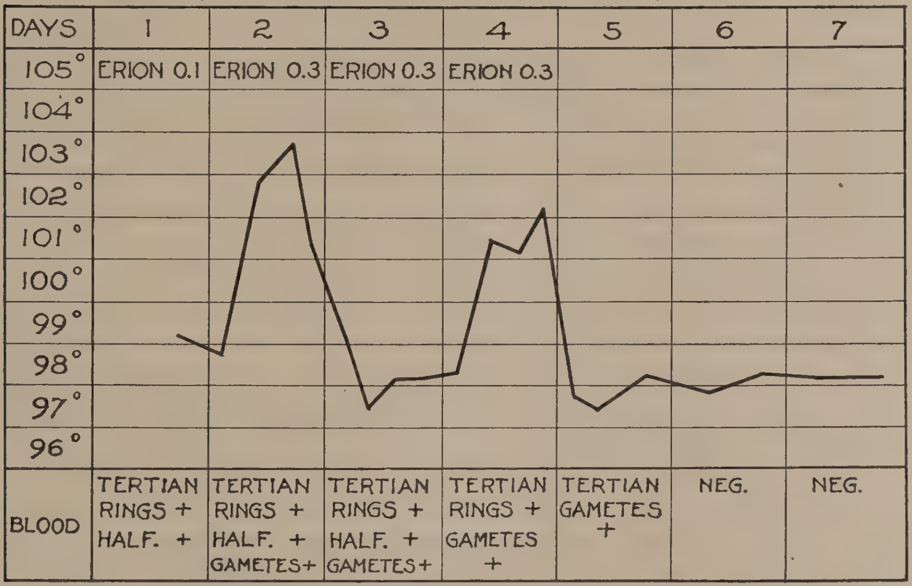


CHART No. 1

The administration of Atebrin caused no inconvenience to the patients; and none of them complained of gastrointestinal or nervous discomfort in consequence of the drug. Only in one case—a girl with a neurotic temperament—repeated vomiting occurred. Several volunteers took 0.3 gram of Atebrin in one dose on an empty stomach, with no untoward effects. Another healthy person took 3 grams within five days, without any trouble. The drug has apparently no effect on the urine, blood pressure, and leucocyte count. One anemic white patient, with a heavy malaria infection, developed a yellowish tinge of the skin on the third day of Atebrin treatment; but the discoloration faded within a week after the drug was discontinued.

There were 114 cases of estivo-autumnal malaria treated; 6 of tertian, and 1 of quartan. In acute cases with seemingly recent infections, the effect of Atebrin became evident on the second or third day—the temperature fell to normal, and general distress was relieved after 48 to 72 hours (see Charts Nos. 1 and 2). Only in three cases did a slight feverish reaction persist until the fourth day. We never saw more than two paroxysms with chills and sweating after the initiation of Atebrin treatment. Many cases, most of which were sub-acute or relapsing malaria, were free of fever within the first 24 hours. There was no difference observed in the effect of the drug on estivo-autumnal and tertian infections.

C.de A., FEMALE, SPANISH, WHITE, 43 YRS.



DAYS	1	2	3	4	5	6	7
105°	ERION 0.1	ERION 0.3	ERION 0.3	ERION 0.3			
BLOOD	TERTIAN RINGS + HALF. +	TERTIAN RINGS + HALF. + GAMETES+	TERTIAN RINGS + HALF. + GAMETES+	TERTIAN RINGS + GAMETES +	TERTIAN GAMETES +	NEG.	NEG.

CHART NO. 2

Along with the relief of clinical symptoms, asexual parasites in the peripheral blood diminished and disappeared. Most cases were negative for ring forms after three full days of Atebrin treatment; and it was especially noticeable that those with high fever and many parasites always reacted favorably. In some sub-febrile or afebrile estivo-autumnal cases, with a few ring forms in the peripheral blood, parasites were found up to the fifth or sixth day (see Chart No. 3). Gametes of tertian malaria disappeared together with the disappearance of the asexual forms or persisted one day longer. Crescents were apparently not affected, even with prolonged Atebrin treatment; and they developed and remained in the blood, as occurs in cases treated with quinine. Of 114 patients with estivo-autumnal malaria, 37 showed crescents at some time during the observation period.

All patients had an uneventful recovery; hemoglobin increased; and spleen tumors generally diminished in size.

Three patients relapsed after 5, 8 and 12 weeks respectively, with fever and reappearance of parasites—in one of these cases there was the probability of reinfection. Some patients could not be followed up, while others were under observation for too short a period; and consequently the number of relapses cannot be stated in exact figures.

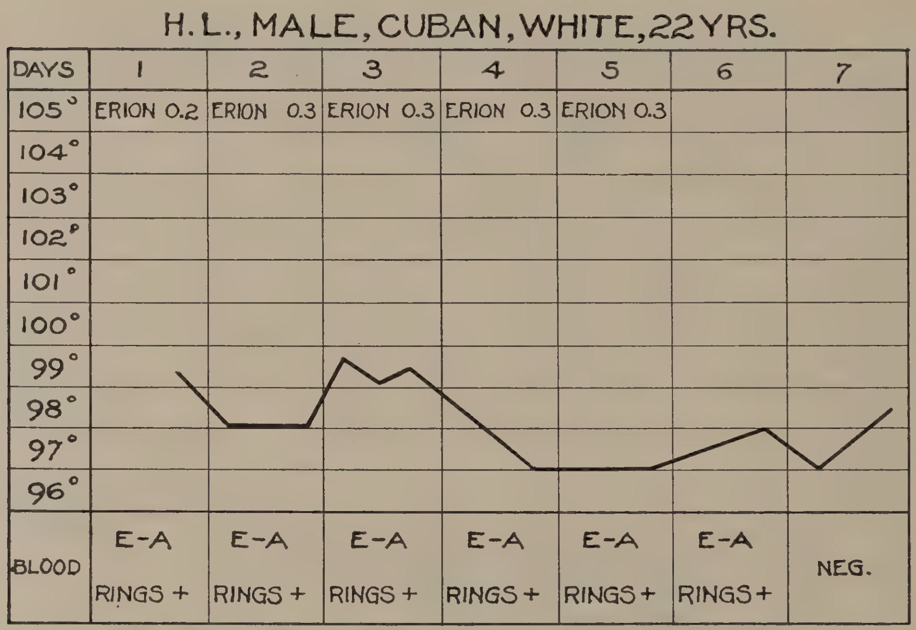


CHART No. 3

There were 9 cases of hemoglobinuria treated with Atebrin. Four of these presented the classical picture of blackwater fever; while the clinical manifestations were less severe in the others. All had suffered from more or less protracted estivo-autumnal malarial infection, and the onset of their hemoglobinuria could definitely be linked up with the intake of a dose of quinine. Atebrin was given in these cases only when parasites were present or reappeared in the blood, which was generally five or six days after the paroxysm; and in all instances the blood became free of parasites after the administration of Atebrin. In no instance did Atebrin provoke another attack of hemoglobinuria. One patient died on the 16th day, from suppression of urine and uremia; but the others recovered, and none of them has experienced a relapse up to now (Feb. 1st, 1932).

One case deserves special mention. A white Cuban boy, 13 years old, had chronic estivo-autumnal malaria and suffered a severe attack of blackwater fever. Anuria persisted for 36 hours. The spleen tumor reached to the umbilicus; and the hemoglobin was 24%. Ten days later there was a rise of temperature, and ring forms of estivo-autumnal parasites were present again in the blood film. Two grains of quinine were given; and a violent paroxysm followed promptly, with a temperature of 104°F. and hemoglobinuria. The boy was in a serious condition. The hemoglobin estimate dropped to 18%. Three days later Atebrin was given—0.2 gram daily for three days. No untoward reaction ensued; the parasites disappeared; and he made a remarkable recovery. Within three weeks his hemoglobin increased to 56%; and the spleen was reduced to a level with the rib arch. It is now five months since his convalescence, and no relapse has occurred.

COMMENTS

Numerous attempts have been made to dethrone cinchona bark from its dominating place in malaria therapy. Before and after the advent of experimental chemotherapy, various drugs (e.g., methylene blue and salvarsan) have been hailed as possessing specific anti-plasmodic qualities, only to be found wanting after a short period of optimistic investigation and experimentation. The discovery of Plasmochin, some years ago, provided an additional weapon against malaria, and especially against the sexual form of the parasite; but its clinical range of action is limited. Although it is far from being an absolutely perfect agent for the cure of malaria, quinine still holds the leading place in individual and mass treatment; and for good and substantial reasons.

Certain requirements are fundamental for a remedy which is to be recommended and adopted for general use in the treatment of malaria. Its action on the fever symptom must be quick and reliable; it must prove efficacious in the prevention of relapses; its dosage should be simple, and its administration easy and without discomfort; its toxicity must be low, so that it may be taken without constant medical supervision. These conditions are fulfilled, in our opinion, by the new product—Atebrin. The above-described trials prove that Atebrin has a decidedly curative influence on all of the clinical manifestations of estivo-autumnal and tertian malaria. We have not seen one failure in 121 cases. The curative effect is established on the third or fourth day, in acute febrile cases; and earlier in many of the milder cases. Within the same period, except in a few instances, all parasites disappear from the peripheral blood. Only the gametes of Plasmodium falciparum do not seem to be affected.

One treatment of three days duration, corresponding to 1 gram of Atebrin, effects a complete cure in most cases. It must be stated, however, that relapses do occur in some instances; but our experience with the drug is not yet sufficiently extensive to enable us to reach any definite conclusions as to the percentages. However, after taking into consideration other factors which are prone to complicate the attempts to determine the percentage of relapses (reinfection, latent infection, insufficient time of control, etc.), we are inclined to believe that 75% of all patients are definitely cured by one routine treatment of Atebrin. It seems reasonable to presume that more prolonged or repeated medication would yield still better results.

Unlike quinine, Atebrin does not cause any dizziness or other subjective discomfort. It is taken readily by persons who have an idiosyncrasy to quinine or who refuse to take it because of its disagreeable effects—a most important factor in the mass treatment of a malaria-ridden population. The toxic action of exaggerated doses of Atebrin is not yet well established. We were warned by the manufacturers that there sometimes appears, after several days of Atebrin treatment, a yellow discoloration of the skin. It is more pronounced in the covered parts of the skin and leaves the sclerae free; and, at the same time, there is no bile detectible in the urine. This phenomenon, which we observed once, is not the expression of hemolysis and bilirubinemia (as in some Plasmochin cases); but is due to the pronounced coloring quality of the drug. Apart from this staining of tissues, Atebrin, in reasonable doses up to 2 or even 3 grams, does not provoke any ill effects.

The results in blackwater fever were most gratifying. This grave complication of protracted malaria is, in many instances, undoubtedly precipitated by an unwise dosage of quinine; and often a serious dilemma arises in treating such cases—especially when febrile symptoms return and parasites appear again in the blood after the attack of hemoglobinuria. In some cases, even a minimal dose of quinine is liable to provoke another severe paroxysm of hemoglobinuria. Our cases, which probably all belonged to the group of quinine hemoglobinuria, could take Atebrin without any ill effects and were cured of their malaria. Atebrin has apparently nothing to do with the intricate mechanism of hemolysis. One may doubt whether the established syndrome of blackwater fever, especially the dangerous anuria, is amenable to any medical treatment. We are, however, always confronted with the necessity of treating the underlying or concomitant malaria. In such cases, as well as in all instances of quinine idiosyncrasy, Atebrin may prove a very welcome agent.

There still remain many factors to be determined before Atebrin can assert itself as an adequate and general substitute for quinine—we shall only mention here that the methods of parenteral medication are not yet sufficiently developed. The object and result of our experiments was to demonstrate the conspicuous effect of Atebrin on malaria plasmodia; its favorable influence on the clinical course of malaria; and, last but not least, its compatibility.

THE TREATMENT OF MALARIA WITH ERION (ATEBRIN), A NEW SYNTHETIC DRUG—REPORT OF 75 CASES

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In March, 1931, one of us, (E.T.-N.) received from Professor Muehlens, of the Hamburg Tropical Institute, a synthetic product for experimental use in natural malarial infection of man. This product carried the laboratory name Erion; but will be known commercially as Atebrin, and the author will refer to it by the latter name in this paper. It is an intensely yellow powder; and, for experimental purposes, was supplied in tablets, each of which contained 0.1 gm. The first shipment we received contained 0.01 gm. of pure Plasmochin, in addition to the 0.1 gm. of Atebrin. Subsequently it was deemed more practical to allow the individual observers to determine how they wanted to combine Atebrin and Plasmochin; and both drugs were consequently supplied separately.

The efficacy of Atebrin for the cure of malaria had been proved in Europe by chemo-therapeutical experiments with bird malaria and with natural and induced malarial infections of man, before we were called upon to conduct experiments in a tropical environment. Further experiments had determined the therapeutic limits between which Atebrin could efficaciously and safely be used; and it had been ascertained that the therapeutic optimum lay far below the minimum toxic dose.

The dosage of Atebrin, which the first observers had found both safe and effective, was 0.2 or 0.3 gram daily, given over a period of several days. It was left to us to determine the definite period of treatment necessary to establish a cure. In cases of E.A. malaria, we were advised to use it in combination with pure Plasmochin, as the gametes of P. falciparum did not yield to Atebrin.

From March, 1931, to November, 1931, seventy-five patients (64 adult males, 10 adult females and one child) were treated. During treatment, each patient's blood was examined daily by the thick film method stained with Giemsa's stain; and twice the routine time was spent on each film in search for parasites. There were 43 of the cases who were re-examined after the termination of the treatment; and 11 of these had 4 or more re-examinations of their blood. The longest period between the termination of treatment and the last re-examination was 9 weeks.

Throughout the series, we adhered to the dose of 0.3 gm. of Atebrin daily, which was given in doses of 0.1 gm. three times a day. It was soon found that this amount, given over 5 or 6 consecutive days, gave most satisfactory results, as the clinical symptoms subsided and the parasites disappeared from the blood stream. The only adverse result observed was that the gametes of P. falciparum did not disappear, but seemed to increase in number under treatment with Atebrin alone. For this reason, Atebrin was supplemented by pure Plasmochin in 59 cases.

Explanation of Tables: The results we obtained are recorded in the accompanying tables. In Tables I and II, under the heading "Clinical Observations," are charted a few outstanding clinical features in individual cases which were noticed on admission and during the course of treatment. The term "recurrency" in this column applies only to relapses which occurred before the Atebrin treatment was started.

The effects of treatment were considered satisfactory when the temperature returned to normal and parasites disappeared from the peripheral blood. The amount of Atebrin, and Atebrin and Plasmochin, respectively, required to bring about these effects is shown in the tables by recording the number of tablets given before these symptoms disappeared.

The abbreviation "n.f." indicates that the patient had no fever during the period of observation.

In the column headed "Tablets before blood was freed from rings" are charted the schizonts of P. falciparum and tertian malaria, and also the tertian gametes.

C+, C++, or C+++ respectively, indicates that crescents (C) were still present in the blood when treatment was terminated.

"Relapse" refers to the re-appearance of any form of parasites in the blood after the treatment had been terminated.

SUMMARY AND COMMENTS

Seventy-five cases of malaria were treated with Atebrin, which is a new synthetic drug. They included 59 E.A., 10 tertian and 6 mixed (E.A. and tertian) infections. Six were primary infections, and six were old chronic infections. Twenty-one cases of E.A., and E.A. and tertian mixed infections, were highly toxic; and five of these were accompanied by cerebral symptoms.

A dosage of 0.3 gm. of Atebrin was given daily, as a rule, over a period of 5 consecutive days. In 59 cases, Atebrin was administered in combination with 0.03 to 0.06 gm. of pure Plasmochin daily, given over the same period. Only in 4 instances did the total amount of Atebrin exceed 1.5 grams (15 tablets). The largest amount of Atebrin given, in one case, was 2.1 grams (21 tablets). In 3 cases of comatose malaria, intramuscular injections of quinine, totalling not more than 20 grains in each case, were resorted to.

Atebrin was taken very willingly by all the patients.

EFFECTS OF TREATMENT

Table I:—Atebrin alone cured 16 cases of malaria—clinically as well as protozoologically. In addition to Atebrin, one case received 15 grains of quinine intramuscularly. These included 10 cases of E.A. malaria (five of which were severely toxic), and 6 cases of mixed tertian and E.A. infections. An average dose

TABLE I

ATEBRIN SERIES—CASES 1 TO 16

Atebrin 0.3 gm. daily

No.	Age	Sex	Diag.	Clinical Observations	Treatment	Tablets Before Temp. Became Normal	Tablets Before Blood was Freed from		Relapse	Periods Between End of Treatments and Re-examinations	Result
							Rings	Cres.			
1	29	M	E.A.	Severe toxic primary infection. Nephritis. Rings ++++.	Atebrin 5 days	7	15	0	0	10 days	Neg.
2	19	M	E.A.	Chronic malaria. Rings +.	Atebrin 4 days	n.f.	3	0	0	0	—
3	28	F	Tert.	Mild recurrence. Pregnant 4th mo. Undisturbed progress of pregnancy. Rings ++.	Atebrin 5 days	n.f.	3	0	0	0	—
4	35	M	E.A.	Old infection. Rings ++.	Atebrin 5 days	3	3	0	0	0	—
5	26	F	Tert.	Obstinate recurrency. Took much quinine before.	Atebrin 5 days	9	11	0	0	4 weeks	Neg.
6	16	M	E.A.	Severe, toxic primary infection. On 3rd day after admission, quinine grs. 15 intramuscularly. Rings ++++ on admission.	Atebrin 5 days. Quinine grs. 15 one dose	9	15	C+	0	8 days	Neg.
7	25	M	Tert.	Moderately severe case. Rings ++++.	Atebrin 5 days	3	9	0	0	0	—
8	31	F	Tert.	Rings ++++.	Atebrin 5 days	6	7	0	0	0	—
9	Ad	M	E.A.	Cerebral malaria. Rings ++++; 20 grs. of quinine intramuscularly, on account of comatous condition, received on admission.	Atebrin 5 days. Quinine 20 grs. on first day	6	6	C++	0	1 and 2 wks. C negative after 3 days follow-up treatment with pure Plasmochin, 0.3 gm. daily.	Neg.
10	28	M	E.A.	Very toxic case; W. B. C. 18000; Rings ++++; acute nephritis; urine negative at end of treatment.	Atebrin 5 days	15	15	C+	0	1, 2 & 3 wks. C negative after follow-up treatment with pure Plasmochin 0.12 gm.	Neg.
11	16	M	E.A.	Rather severe primary infection. Rings ++++.	Atebrin 5 days	7	7	C++	0	1, 2, 3, 10, and 14 days	Neg.
12	18	M	E.A.	Rather severe primary infection. Rings ++++.	Atebrin 5 days	8	5	C+++	0	8 days. C negative after 0.18 gm. Plasmochin	Neg.
13	Ad	M	Tert.	Recurrency. Rings ++++.	Atebrin 5 days	3	9	0	0	0	—
14	26	M	E.A.	Cerebral symptoms. Few rings in blood.	Atebrin 5 days	6	9	0	0	0	—
15	20	M	Tert.	Recurrency. Rings and adults ++++.	Atebrin 5 days	4	7	0	0	0	—
16	40	M	E.A.	Old Case. Rings +.	Atebrin 5 days	1	4	C+	0	0	—

TABLE II

ATEBRIN WITH PURE PLASMOCHIN—CASES 17 TO 75

Group 1: (Cases 17 to 60). Atebrin 0.3 gm., plus pure Plasmochin 0.03 gm. daily

No.	Age	Sex	Diag.	Clinical Observations	Treatment	Tablets Before Temp. Became Normal	Tablets Before Blood was Freed from		Relapse	Periods Between End of Treatments and Re-examinations	Result
							Rings	Cres.			
17	25	M	E.A.	Chronic malaria. Few rings. On 2nd day of treatment cervical adenectomy was performed.	Atebrin and Plasmochin 5 days	n.f.	3	0	0	8 and 10 days	Neg.
18	22	M	E.A. & Tert. mixed	Severe infection. Rings ++++. Tertian gametes ++.	Atebrin and Plasmochin 5 days	6	9	15	0	1, 2, 3, 4 and 15 days	Neg.
19	29	F	E.A.	Clinically severe case. Rings ++++.	Atebrin and Plasmochin 4 days	12	6	12	0	1, 2, 3, 4, 5 and 20 days	Neg.
20	26	M	E.A.	Rings and crescents ++++.	Atebrin and Plasmochin 5 days	n.f.	6	9	0	19 days	Neg.
21	26	M	E.A.	Chronic malaria. Rings and crescents ++++.	Atebrin and Plasmochin 5 days	n.f.	3	6	0	4 days	Neg.
22	27	M	Tert.	Recurrency, light - few rings and adults.	Atebrin and Plasmochin 5 days	n.f.	3	0	0	8 weeks	Neg.
23	30	F	Tert.	Heavy infection. Pregnant. Delivery 3 hrs. before treatment. Normal puerperium.	Atebrin and Plasmochin 5 days	3	3	0	0	1, 2, 3 and 5 days	Neg.
24	24	M	E.A.	Chronic malaria. Rings ++.	Atebrin and Plasmochin 5 days	3	3	0	0	1 to 12 days, and 9 weeks	Neg.
25	21	M	E.A.	Rings +.	Atebrin and Plasmochin 5 days	n.f.	6	12	0	5 weeks	Neg.
26	19	M	E.A.	Rings ++++.	Atebrin and Plasmochin 5 days	n.f.	12	0	0	0	—
27	24	M	E.A.	Severe infection. Rings ++++. Vomiting.	Atebrin and Plasmochin 5 days	5	15	0	2 days after treatment—a few rings, which disappeared without further treatment.	3, 4, 5 and 6 days	Neg.

28	27	M	Tert.	Obstinate tertian recurrency; had taken much quinine before.	Atebrin and Plasmochin 5 days	n.f.	6	0	0	2 days, and 3 and 5 weeks	Neg.
29	46	M	E.A.	Severe primary infection. Rings ++++.	Atebrin and Plasmochin 5 days	5	6	C+	0	1 and 2 days, and 2 weeks	Neg.
30	4	M	Tert.	Heavy infection. Rings ++++.	Atebrin and Plasmochin, ½ doses, 5 days	1.5	4.5	0	0	2 weeks	Neg.
31	26	M	E.A.	Severe infection. Rings and crescents ++++.	Atebrin & Plasmochin 5 days	3	3	C+	0	0	—
32	23	M	E.A.	Rings ++.	Atebrin & Plasmochin 5 days	n.f.	3	15	0	0	—
33	26	M	E.A.	Severe infection. Rings ++++ Acute nephritis.	Atebrin & Plasmochin 5 days	9	9	C+	0	5 days	Neg.
34	23	M	E.A. & Tert.	Rings +++.	Atebrin & Plasmochin 5 days	3	3	15	0	5 days	Neg.
35	18	M	E.A. & Tert.	Rings and tertian gametes ++++.	Atebrin & Plasmochin 5 days	9	3	C+	0	6 days	Neg.
36	28	M	E.A.	Very severe cerebral, comatous malaria. Rings ++++; icterus; vomiting; acute nephritis. Quinine grs. 20 intramuscularly on 3rd day of treatment.	Atebrin & Plasmochin 5 days; plus Quinine grs. 20, 1 dose.	6	9	C+	0	6 days	Neg.
37	28	M	E.A.	Mild recurrency after humerus fracture (before treatment).	Atebrin & Plasmochin 5 days	n.f.	3	0	0	1, 2, 3 & 4 days	Neg.
38	50	F	E.A.	Very toxic case, in a soporous condition. Rings ++++. Vomited food and medicines, which perhaps explains short recurrency after end of treatment.	Atebrin & Plasmochin 5 & 2 days	6	21	0	After first 5 days treatment a few rings.	Daily examinations for 16 days following end of treatment	Neg.
39	32	M	E.A.	Very toxic case. Rings ++++. Herniotomy 15 days after end of treatment.	Atebrin & Plasmochin 5 days	9	12	C+	0	Daily examinations for 15 days; and one after 4 wks.	Neg.
40	16	F	E.A.	Severe infection. Rings and crescents ++++. Pregnant 7th month; undisturbed by treatment.	Atebrin & Plasmochin	9	6	C+	0	0	—

TABLE II—*Concluded*

No.	Age	Sex	Diag.	Clinical Observations	Treatment	Tablets Before Temp. Became Normal	Tablets Before Blood was Freed from		Relapse	Periods Between End of Treatments and Re-examinations	Result
							Rings	Cres.			
41	15	F	E.A.	Chronic malaria. Rings ++. 1 ring was found 2 days after end of treatment, but, after 3 additional tablets of Atebrin and Plasmochin, blood was negative again.	Atebrin & Plasmochin 5 days and 1 day follow-up treat.	8	15	6	2 days after end of treatment	3, 4, & 5 days	Neg.
42	36	M	E.A.	Moderately severe case. Rings ++++.	Atebrin & Plasmochin 5 days	3	6	15	0	0	—
43	25	M	E.A.	Mild Case. Rings +.	Atebrin & Plasmochin 5 days	n.f.	9	0	0	0	—
44	26	M	E.A.	Chronic malaria. Rings ++.	Atebrin & Plasmochin 5 days	3	3	0	0	0	—
45	26	M	E.A.	Rather toxic case. Rings +++.	Atebrin & Plasmochin 5 days	n.f.	3	C+	0	0	—
46	32	M	E.A. & Tert.	Moderately severe mixed infection. Tertian ++.	Atebrin & Plasmochin 5 days	3	6	9	0	0	—
47	35	M	E.A.	Severe primary infection. Rings ++++. Acute nephritis—urine negative at end of treatment.	Atebrin & Plasmochin 5 days	9	6	0	0	0	—
48	26	M	E.A.	Recurrency of chronic malaria after operation for inguinal adenitis. Rings +.	Atebrin & Plasmochin 5 days	3	3	0	0	1, 2, 3, 4, & 14 days	Neg.
49	19	F	E.A.	Severe, toxic infection. Rings and crescents ++++. Premature delivery before treatment was begun. On 2nd day after end of treatment a few rings were found. 3 days follow up treatment with 3 tablets Atebrin and Plasmochin daily. Blood negative after 1 day treatment. Normal puerperium.	Atebrin & Plasmochin 5 days & 3 days	3	15	6	2 days after end of 5 days treatment	Daily examinations from 3rd to 8th day, and one after 22 days	Neg.

50	26	M	E.A.	Severe, toxic case. Rings +++.	Atebrin & Plasmochin 5 days	3	15	0	0	1, 2, 3, & 4 days	Neg.
51	25	M	E.A. & Tert.	Recurrency, very obstinate. Rings +++.	Atebrin & Plasmochin 5 days	n.f.	7	C+	0	8 days	Neg.
52	30	M	E.A. & Tert.	Severe infection. Rings and tertian gametes ++++.	Atebrin & Plasmochin 5 days	2	2	6	0	4 days	Neg.
53	26	M	E.A.	Cerebral malaria. Rings +.	Atebrin & Plasmochin 5 days	12	6	0	0	1 day	Neg.
54	40	M	E.A.	Probably primary infection. Rather severe case. Rings ++++.	Atebrin & Plasmochin 5 days	7	13	C+	0	8 days	Neg.
55	41	M	E.A.	Rings ++++.	Atebrin & Plasmochin 5 days	4	10	0	0	0	—
56	42	M	E.A.	Rings ++++.	Atebrin & Plasmochin 5 days	6	12	0	0	0	—
57	—	M	E.A.	Rings +++.	Atebrin & Plasmochin 5 days	3	15	0	0	2 days	Neg.
58	—	M	E.A.	Rather severe infection. Rings ++++.	Atebrin & Plasmochin 5 days	6	7	15	0	0	—
59	50	M	E.A.	Recurrency of old chronic malaria after provocation. Rings +.	Atebrin & Plasmochin 3 days	3	1	0	0	0	—
60	30	F	E.A.	Rings and crescents ++++. On 3rd day of treatment, laparatomy for pelvic disease. Quick recovery.	Atebrin & Plasmochin 5 days	12	3	6	0	8 days	Neg.

TABLE III

ATEBRIN WITH PURE PLASMOCHIN

Groups 2 and 3

The 15 cases of E.A. malaria comprised in these two groups were treated with the same dose of Atebrin as the first group, but with slightly higher doses of pure Plasmochin. Special attention was given to the behaviour of the crescents. The patients were all male adults.

Group 2. (Cases 61 to 65.) Atebrin 0.3 gm. plus pure Plasmochin 0.04 gm. daily

No.	**Blood Findings on Admission**	**Tablets before Temp. Became Normal**	**Tablets Before Blood was Freed from**		**Remarks**
			Rings	**Cres.**	
61	Rings ++. No crescents.	7 Atebrin 8 Plasm.	5 Atebrin 6 Plasm.	10 Atebrin 12 Plasm.	A few crescents appeared on the third day of treatment.
62	Crescents ++. No rings.	3 Atebrin 4 Plasm.	No rings	15 Atebrin 20 Plasm.	Constant decrease of the crescents during treatment.
63	Rings +. No crescents.	n.f.	9 Atebrin 12 Plasm.	No Cres.	No crescents appeared during treatment.
64	Heavy infection. Rings and crescents ++++.	n.f.	3 Atebrin 4 Plasm.	C+	A few crescents were found at each examination until the 3rd day after the end of the treatment.
65	Rings ++++. No crescents.	6 Atebrin 8 Plasm	6 Atebrin 12 Plasm.	No Cres.	No crescents appeared during treatment.
Group 3. (Cases 66 to 75.) Atebrin 0.3 gm. plus pure Plasmochin 0.06 gm. daily					
66	Rings +.	n.f.	11 Atebrin 22 Plasm.	14 Atebrin 28 Plasm.	On 3rd day of treatment, a few crescents appeared.
67	Rings ++++. Very heavy infection.	12 Atebrin 24 Plasm.	18 Atebrin 36 Plasm.	C+	On 1st and 3rd day after end of treatment, a few crescents appeared; but they disappeared without further treatment.
68	Rings ++. No crescents.	6 Atebrin 12 Plasm.	9 Atebrin 18 Plasm.	15 Atebrin 30 Plasm.	A few crescents appeared on the 4th and 5th day of treatment.
69	Rings ++. No crescents.	15 Atebrin 30 Plasm.	3 Atebrin 6 Plasm.	C+	A few crescents appeared on the 5th day of treatment; and again on the 2nd day after the treatment. They disappeared without further treatment.
70	Rings +++. No crescents.	n.f.	18 Atebrin 36 Plasm.	18 Atebrin 36 Plasm.	A few crescents appeared during treatment. They disappeared, together with the rings, after 6 days of treatment.

TABLE III—*Concluded*

No.	Blood Findings on Admission	Tablets Before Temp. Became Normal	Tablets Before Blood was Freed from		Remarks
			Rings	Cres.	
71	Rings +++. No crescents.	6 Atebrin 12 Plasm.	6 Atebrin 12 Plasm.	No Cres.	No crescents appeared during treatment.
72	Rings +++. No crescents.	9 Atebrin 18 Plasm.	9 Atebrin 18 Plasm.	No Cres.	No crescents.
73	Rings ++. No crescents.	4 Atebrin 8 Plasm.	4 Atebrin 8 Plasm.	No Cres.	No crescents.
74	Rings ++++ No crescents.	2 Atebrin 4 Plasm.	8 Atebrin 16 Plasm.	No Cres.	No crescents.
75	Rings ++++. No crescents.	n.f.	6 Atebrin 12 Plasm.	6 Atebrin 12 Plasm.	A few crescents appeared on the 2nd day of treatment. They disappeared again the next day.

of 6.5 tablets of Atebrin brought the temperature down to normal—the tertian cases required 5 tablets and the E.A. cases 7 tablets. The schizonts of E.A. malaria disappeared from the blood stream after an average of 8.2 tablets, and the tertian parasites after 7.6 tablets. In 6 of the 10 E.A. cases (60%), crescents appeared and were still present in the blood at the end of the 5 days of treatment. Seven cases were reexamined after periods varying from 1 to 4 weeks; and no relapses were observed, nor were any more crescents found.

Tables II and III:—Atebrin and pure Plasmochin were combined, in cases Nos. 17 to 75. With this combined treatment, the temperature in the 43 cases who had fever on admission became normal after an average dose of 6 tablets of Atebrin. The parasites of tertian malaria disappeared after 5 tablets; while the blood became free from the schizonts of E.A. malaria after an average dosage of 8 tablets of Atebrin.

In the 55 cases of E.A. malaria, the crescents re-acted in the following manner —in 8 instances (15%) crescents were present before treatment was started; in 23 cases (42%) crescents appeared under treatment; and in 13 cases (24%) they were still positive at the end of the treatment.

Spleen.—With the exception of those patients who had a hard chronic splenic tumor, there was a rapid reduction in the size of the spleen—especially in the cases of primary infection.

Symptoms.—The subjective symptoms which usually accompany a malarial infection subsided when the temperature came down to normal. The patients recovered quickly; and low haemoglobin values rose rapidly.

Relapses.—In the 123 re-examinations of the blood of 43 patients, extending over varying periods up to 9 weeks after the termination of treatment, only 3 relapses were observed. They were manifested by the re-appearance of a few rings in the blood within 2 days after the 5 days of treatment had terminated, and without the return of clinical symptoms. To the best of our knowledge, none of the 75 patients returned to the hospital or was treated at the dispensaries for malarial symptoms within three months after the completion of the course of treatment with Atebrin. No artificial provocations were attempted; but, during as well as shortly after the treatment, several major surgical operations were performed without producing recurrencies. In the pregnant women who submitted to the Atebrin treatment before labor had set in, the course of pregnancy continued without any disturbance.

BY-EFFECTS

Frequent urine examinations, during and after the treatment, revealed no irritation of the kidneys or the liver. The acute nephritis, which frequently accompanies severe malarial infections, cleared up without exception during the course of treatment.

A rather intense yellowness of the skin was noticed in most of the clear skinned patients, after 4 or 5 days of treatment; but the sclerae were not stained, and no bile pigments were found in the urine.

Untoward gastrointestinal symptoms did not, in any instance, follow the administration of Atebrin alone; but, in the Atebrin and Plasmochin series, 30 of the 59 patients complained of "gas-pains" in the epigastrium accompanied by constipation. They were similar to the pains observed occasionally under Plasmochin treatment alone, and occurred usually on the 4th or 5th day of treatment—in the average after 14 or 15 tablets of pure Plasmochin (0.01 gm. each) had been administered. No other by-effects were noticed.

COMMENTS

The treatment of 75 cases of E.A. and tertian malaria has given us the rather spectacular result *of curing all the patients within 1 week or less.* In 4 instances in which a few rings appeared shortly after the termination of the 5 days course of treatment, a few additional doses of Atebrin and Plasmochin resulted in clearing up the infection.

Atebrin does not destroy the crescents; but seems to provoke their appearance, even to a greater degree than quinine alone does. Carroll (Annual Report, 1927) reported that in 90 cases of E.A. malaria treated with quinine sulphate, 3 grams daily, 20% developed crescents; and Menk (Annual Report, 1927) stated that out of 35 cases receiving 2 grams of quinine daily, 26% showed crescents under treatment; while they appeared in 6 out of 10 cases (60%) under administration of Atebrin 0.3 gram daily (See Table I of this paper). For this reason, Plasmochin, with its specific action upon the sexual forms of E.A. malaria, should be used in combination with Atebrin; although it will be noted that 42% of our cases showed crescents during treatment with this combination, whereas Menk (Annual Report, 1927) and Brosius (Annual Report, 1928) reported that they appeared in only 10% to 17% in series of cases treated with quinine combined with Plasmochin. After the Atebrin and Plasmochin treatment, 24% of the cases still showed crescents; *but they were found only in very small numbers in the blood smears.*

The observation of several blood films, taken during the first 24 hours of treatment, indicated that Atebrin must be absorbed very quickly by the organism. A prompt and steady decrease in the number of the parasites set in, after the first few doses.

In the E.A. cases, the temperature was usually lower the second day and normal on the 3rd. In the tertian cases, there was frequently no second rise in temperature.

The 3 patients with a cerebral type of pernicious malaria, who received 1 to 3 injections of quinine, were in a precomatose condition and vomited frequently. However, our increasing confidence in the efficacy of Atebrin caused us to abstain from the use of quinine injections in at least 15 toxic cases with heavy infections; and the results justified this action. (See case 10.)

The yellow discoloration of the skin of some of the patients was the only untoward symptom, due to Atebrin, that we noticed. The staining was neither icteric, nor due to anemia; but was a discoloration of the skin similar to that produced by carotin. We exposed several patients to sunlight, without noticing any increased photosensibility of their skin.

The abdominal pains and constipation, which we observed in about half of the cases treated with Atebrin and Plasmochin, varied in intensity from slight discomfort to rather severe cramps. (The Atebrin series was completely free from these disturbances.) In the Atebrin and Plasmochin series, they were most pronounced in Group 3 which received 0.06 gm. of pure Plasmochin daily. X-ray examinations of the bowels revealed a hyper-peristaltic stomach and spastic contractions of the small and large intestine. In Group 2, eleven cases received Tr. belladonna, 20 m. t.i.d., from the beginning; and we succeeded, 9 out of 11 times, in keeping the patients free from pain.

We have been notified that this symptom has not been observed by investigators in Europe or in other tropical countries. We mentioned in a previous report (Nineteenth Annual Report, 1930, pages 68 and 69) that the high incidence of chronic intestinal infections with E. histolytica, along with other factors, might be the cause of the dyskinetic constipation that we observe with unusual frequency, in our patients in this region. The stools of 45 patients in this series were examined; and, with the exception of two, all of them showed in a single stool examination a helminthic or protozoal infection or both. The presence of these parasites may possibly be connected with the abdominal pains observed in this series. We are only at the beginning of our observations in this direction.

CONCLUSIONS

We believe that the results obtained with Atebrin, in our 75 cases of malarial infection, justify its application on a large scale. Traces of the drug have been detected in the urine as long as 36 days after the last dose was given; and we saw a slight yellow discoloration of the skin lasting as long as 2 weeks after treatment with Atebrin was discontinued. This indicates a slow elimination of Atebrin, which should commend it for prophylactic use.

Of further interest will be (a) ambulatory treatments with Atebrin and Plasmochin, on a large scale; and (b) the continuation of Barber's original work on the effect of small doses of Plasmochin upon the viability of the gametes of P. falciparum, so as to determine the results when Plasmochin is given in combination with Atebrin.

NOTE: The author is unable to give any bibliographical references, as he has seen no publications on the subject up to the time that this paper is submitted.

SUPPLEMENTARY DATA

Report on a Trial Camp Treatment with Atebrin and Plasmochin in Paulina Farm

A malaria survey of Paulina Farm (Colombia) which was made in December, 1931, showed 43% infection; and was followed by a blanket treatment of the whole camp by administering to each individual 20 grs. of quinine daily for 7 days and 0.02 gm. of pure Plasmochin on the first and seventh day.

Another survey of this camp, (the initial survey of our experiment) was made on March 1st, 1932; and showed an infection rate of 50%. We had sufficient Atebrin on hand to treat only 21 infected persons; and, consequently, 13 other individuals in the same camp were subjected to a quinine and plasmochin treatment similar to that administered in the above-mentioned blanket treatment. The patients who received the Atebrin treatment were given 3 tablets (0.1 gm. each) daily for 5 days, followed by 2 Compound Cathartic pills (to prevent stomach disturbances); and then 0.01 gm. of Plasmochin t.i.d. for 3 additional days.

The Atebrin, as well as the quinine and Plasmochin, was administered to the respective patients by the Sanitary Inspector, who determined that they actually swallowed the prescribed dose. He visited the camp twice daily, during the course of treatment; and gave each patient in the Atebrin series 2 Atebrin tablets in the morning and 1 Atebrin tablet in the evening, and each patient in the quinine series 10 grs. of quinine in the morning and a similar dose in the evening.

On the day after the last Plasmochin tablet in the Atebrin course of treatment, and the last dose of 10 grs. of quinine and 0.01 gm. of Plasmochin in the quinine or "control" course of treatment, had been administered; a second survey was made, in which all treated persons were included. The results were:

(a) Among the 21 patients in the Atebrin series, 3 infections were found—1 with E.A. rings, and 2 with E.A. rings and crescents—equal to 14%.

(b) Among the 13 patients in the quinine series, 5 infections (1 heavy) were found—equal to 38%.

None of these 34 patients received any further treatment.

Ten days after the completion of the second survey, a third survey was made. Only 20 of the original 34 patients were present. Among the 12 patients of the Atebrin series who were examined, only 1 was infected (E.A. crescents +) —8%. Among the 8 patients of the quinine control series who were examined, 3 infections (1 heavy) were found—37%.

Ten days subsequent to the third survey, a fourth survey was performed in which 32 of the original 34 patients were present. Among the 21 patients of the Atebrin series, there were 5 (24%) infections; whereas, among the 11 patients of the quinine series, there were 7 (64%) positive cases—3 of these 7 infections were heavy, while 1 was a mixed tertian and E.A. infection.

In the fourth survey, a total of 65 persons (including 33 persons who had not been subjected to treatment) were examined; and 43% of these were found positive. Whereas the group that received quinine treatment showed a higher rate of infection than the camp total; the group that received Atebrin showed a lower rate of infection, and there was not one heavy infection nor a crescent carrier among them.

CLINICAL EXPERIENCE WITH ATEBRIN

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Atebrin is described by the manufacturers* as a powder of an intense yellow color, easily soluble in water and with a neutral reaction. It is excreted, unchanged, in the urine and feces; and can be demonstrated by extraction with ether and dissolving the residue, after evaporation, in concentrated sulphuric acid.

The drug was furnished to us in September, 1931, in the form of tablets, each weighing 0.195 gram and containing 0.1 gram of Atebrin. After placing a tablet for a moment on the tongue, a bitter, acrid taste develops. When dropped in 5 c.c. of water at room temperature, a tablet commences to disintegrate immediately; and, upon gentle agitation, the resulting solution becomes bright yellow in color.

The claims of the discoverers of Atebrin are, that it is a chemotherapeutic agent which is especially effective in its action on the schizonts of all types of malaria; that its toxicity is low, with a wide margin of safety between the effective therapeutic dose and the toxic one; that solution and absorption of Atebrin takes place rapidly, but that excretion is relatively slow; and that there is no demonstrable deleterious action of the drug on any part or organ of the body, other than a possible yellow coloring of the skin and tissues (excepting the sclera) when large quantities are taken. This coloration is due to the staining qualities of the drug.

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We must emphasize that our experiences with Atebrin, as recorded herein, are purely clinical and practical. In our work, for economic reasons, it was essential that the patients' health be reestablished as promptly as possible. This meant that syphilis, uncinariasis, ascariasis, diarrhea, skin diseases, anemia, splenomegaly and other diseases must be treated concurrently with existing malaria. Close follow-up control of cases was practically impossible, as most of the patients came from remote areas. With a few exceptions, recurrences could be sought only by checking the readmissions to the hospital or by the field malarial surveys which were performed every three months. Patients who had been treated with Atebrin and had not been readmitted to the hospital, and whose names did not appear among the positive cases found on malarial surveys, were presumed to have remained free from the symptoms of malarial infection.

In estimating the value of drugs in the treatment of malaria, the curative effect of purgation, liquid diet, rest in bed and nursing must be considered; as we have often seen cases of malaria result in clinical and laboratory evidence of cure with no further treatment. We have also observed cases, which had been under continued, intensive, ambulatory treatment without the desired result, become cured speedily when treated in the hospital.

Many of the cases coming under our observation had undergone an ineffective treatment in the camp before admission to the hospital. Some of these had received insufficient or irregular doses of quinine. The number of cases available for treatment with Atebrin would have been very limited, had only those cases previously untreated with quinine been selected.

There were 124 cases of malaria treated with Atebrin in the hospital and hospital clinic. These included both sexes, and children from 2½ years of age and over; but were principally adult males. In the majority of cases, the drug was given in a single morning dose with the idea of testing methods of administration which would be convenient in field treatments. As Atebrin is very slowly excreted; little advantage could be expected from giving it in smaller, frequently repeated doses. In most instances, treatment was instituted on the day of admission and as soon as possible after the thick blood film had been stained and examined. During the patient's stay in the hospital, smears were taken each day before the daily dose was administered; or in rare instances, when the hospitalization was prolonged for other reasons, smears were examined daily until several negatives had been found. In a few instances, it was possible to obtain blood smears, at intervals, long after the patient's discharge from the hospital.

The majority of cases treated had suffered from chronic malaria or from repeated attacks of malaria. About 85% were infections of E. A. (malignant tertian) malaria; and the remaining 15% were tertian (benign tertian). No positive cases of quartan malaria were identified in our series.

Fever was generally present on admission, but in most cases it was impossible to decide whether we were dealing with new infections or with relapses. The spleen was enlarged in most cases; but varied in size from those which were barely palpable below the costal margin, to the enormous spleens extending below the level of the umbilicus or even into the pelvic brim. Anemia was present, to some degree, in the majority of cases.

Our cases were nearly all treated for from five to seven days, at the end of which period they were entirely free from symptoms and able to return to their duties.

No unpleasant symptoms, attributable to the drug, were noted during the treatment with Atebrin. In one case, a profuse diarrhea occurred on the third day of treatment and continued for three days; but the Atebrin was not discontinued, and a few doses of bismuth controlled the symptoms. None of the patients under treatment with Atebrin complained of pain in the stomach, nausea, nervousness nor tinnitus, though these symptoms are common with quinine treatment.

There seemed to be a marked improvement in the general condition of the patient a few hours after the first dose, even tho the fever had not abated. A slight yellow coloration of the skin was noted in several cases. In the patients with dark skins, this was best observed in the palms of the hands.

Relapses among patients treated with Atebrin has not been observed up to the present time (February 18, 1932). It should be understood, however, that, in this section of the country, it is practically impossible to differentiate between relapses and new infections; inasmuch as most patients return to areas where they are continually exposed to the bites of infected anophelines.

Photosensibility in patients treated by Atebrin was not noted. One of us (W. J.) exposed several patients, who were under treatment, to the direct rays of the sun for more than a half hour, with negative results.

Atebrin had no appreciable effect on the size of chronic enlargements of the spleen; but acute splenic enlargements subsided promptly with the improvement of the general condition of the patient. Arsenicals, in some form, were added to the treatment of several cases in which the spleen was persistently large.

Some of the more interesting points in the treatment of these 124 cases are detailed below:

COMMENTS REGARDING CASES TREATED

Fifty-two patients received a daily dose of three tablets. On an average, the blood was free from vegetative forms of the parasite at the end of 3½ days of treatment, or after about 1.05 grams of the drug had been taken. The highest total dosages necessary to secure smears which were negative for schizonts were 18 tablets in one case, and 15 tablets in another case. The lowest total dose necessary was 3 tablets.

In 40 cases fever was present on the first day after admission to the hospital. After an average dose of approximately 0.6 gram of Atebrin (highest 1.8 gms., lowest 0.3 gm.) the fever disappeared.

Gametes appeared in the blood, during treatment, in seven cases. The tertian gametes, which had developed in one of these cases, had not disappeared when the patient was discharged after a total dose of 1.5 grams of Atebrin. In the 6 other cases in which crescents appeared, they disappeared in 2 cases after a dose of 1.2 grams; in 3 cases, after a dose of 1.5 grams; and in 1 case, after a total dose of 2.2 grams of Atebrin and 0.04 gram of plasmochin—the latter drug being administered two days prior to the discharge of the patient from the hospital with a negative blood.

There was a pronounced glomerulonephritis existing in 10 of our cases. The pathological urinary findings improved or entirely cleared up, under Atebrin treatment, in 5 cases; in 3 cases, the condition did not improve; while in the remaining cases, the urine was not checked.

One case developed urticaria on the 8th day after Atebrin treatment had been begun. No connection with the drug could be proved. Another case had suffered a severe attack of hemoglobinuric fever six months previous to this admission, but took Atebrin treatment without incident.

Two patients were treated with Atebrin (0.3 gram daily) from the date of admission and with plasmochin from the second day. Both patients, showing crescents on admission, received 0.3 gram of Atebrin for 6 days and 0.02 gram plasmochin daily for 5 days. The blood smears of both still showed a few crescents when the treatment mentioned above was completed.

Seven patients were treated with 0.4 gram of Atebrin daily. The blood was free from parasites after an average total dose of 1.14 grams of Atebrin (largest dose 1.6 grams, smallest dose 0.8 gram). Four of these cases had fever when they entered the hospital, and the fever had disappeared after an average dose of 0.9 gram of Atebrin.

In three instances, daily doses of 0.4 gram of Atebrin, with plasmochin simplex, were given. The blood became negative in these cases after an average total dose of 1.3 grams of Atebrin and 0.04 gram of plasmochin (Atebrin 0.8 to 1.6 gm.—plasmochin 0.02 to 0.06 gm.). One of these patients had fever, which disappeared on the third day after a total dosage of 0.8 gram of Atebrin and 0.02 gram of plasmochin.

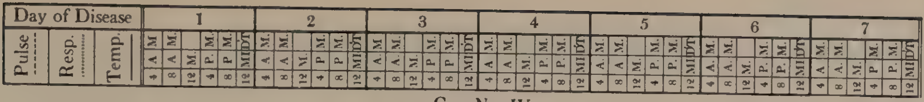
Larger doses of Atebrin than those mentioned previously were given in 4 cases. The highest total daily dosage was 1.2 grams; while the greatest amount given to one individual was 4 grams in 7 days. There were no complaints of discomfort of any sort from the patients. Two cases showed a slight irritation of the kidneys before treatment, with traces of albumin and a few granular casts and red blood cells; and this condition did not change during the treatment. In three of the above mentioned cases, the blood was negative after the patients had taken 1.6 grams of Atebrin. The fourth case still showed vegetative forms of the parasite on discharge from the hospital after the 4th day of treatment with doses of 0.5 gram of Atebrin twice a day. These four cases did not have fever at any time during their stay in the hospital.

Doses of Atebrin smaller than 0.3 gram daily have pronounced beneficial effect. Three cases were treated with 2 tablets of Atebrin daily, and with some irregular supplemental doses of plasmochin. After an average dose of 0.67 gram of Atebrin and 0.067 gram of plasmochin simplex, the blood smears were negative. In one case, crescents, which had appeared during treatment, disappeared also. Fever was present up to the third day in two cases.

One patient, who had high fever with heavy infection, showed no parasites after two daily treatments with 0.2 gram of Atebrin and 0.01 gram of plasmochin simplex. The temperature remained normal after the second day. The patient was discharged after four days treatment in the hospital, and continued to take 2 tablets of Atebrin daily for one week thereafter. The blood was found negative for parasites when examined on the fourth and thirty-fifth day after the completion of treatment, and the urine still showed traces of Atebrin.

A patient, with a heavy infection, was given doses of 0.1 gram of Atebrin daily. The fever disappeared on the third day, and the blood was negative, after a total of 0.5 gram of Atebrin had been given. Another case treated with 0.1 gram of Atebrin daily was free of fever on the third day, and the blood negative after 4 days treatment. Four other cases, of lighter infections, were treated with 0.1 gram of Atebrin daily—in an average of 3 days, they were free of fever; and, in an average of 4 days, their blood was free of parasites.

Thirty cases were treated in the Hospital Dispensary, with 0.3 gram of Atebrin daily.



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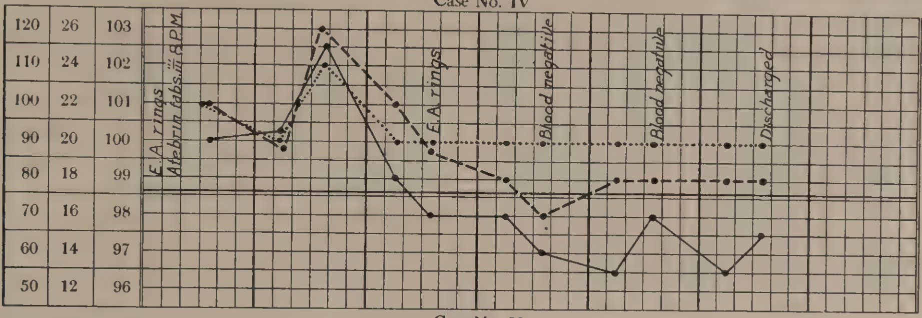

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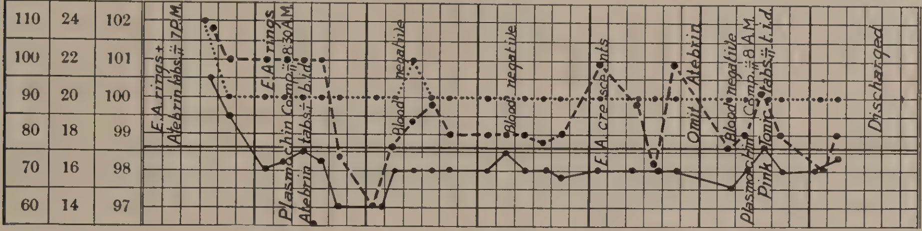

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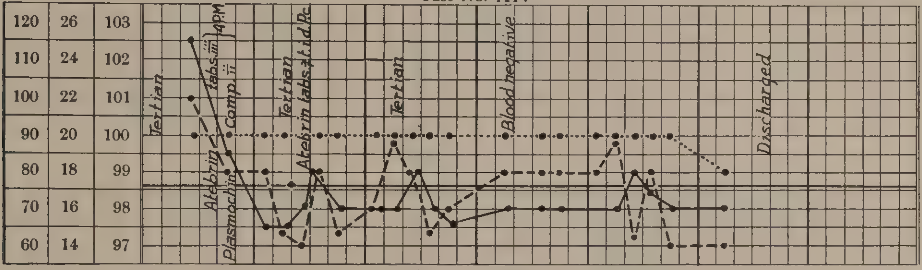

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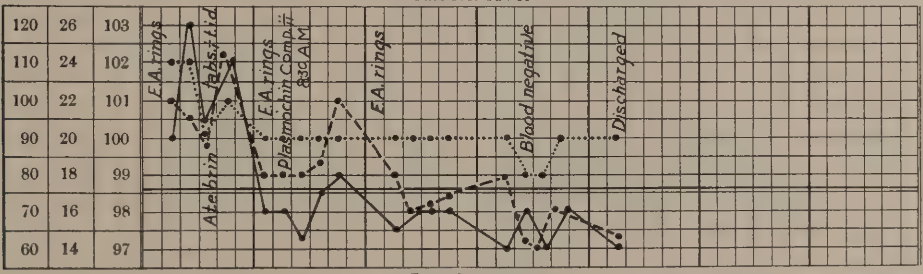

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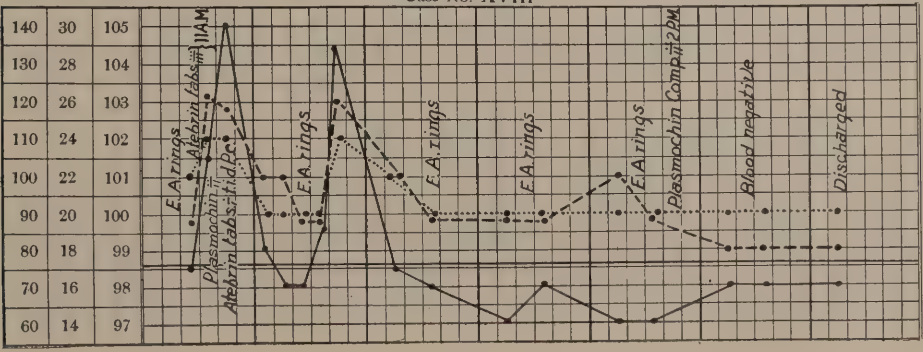

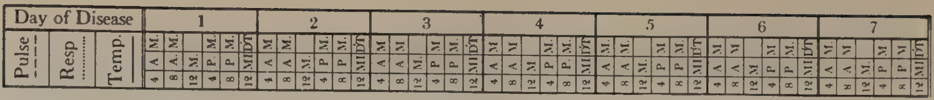

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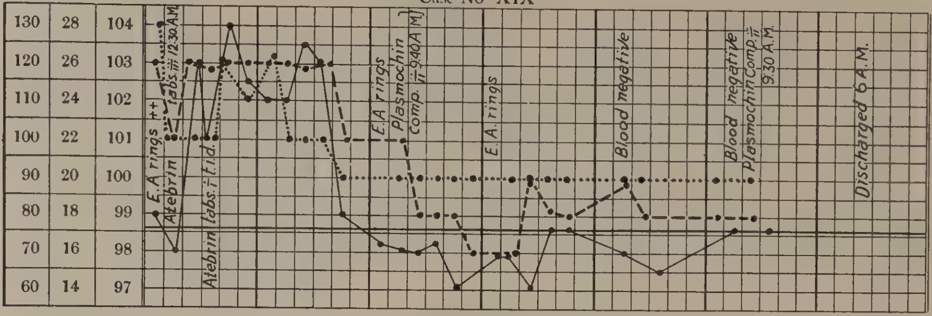

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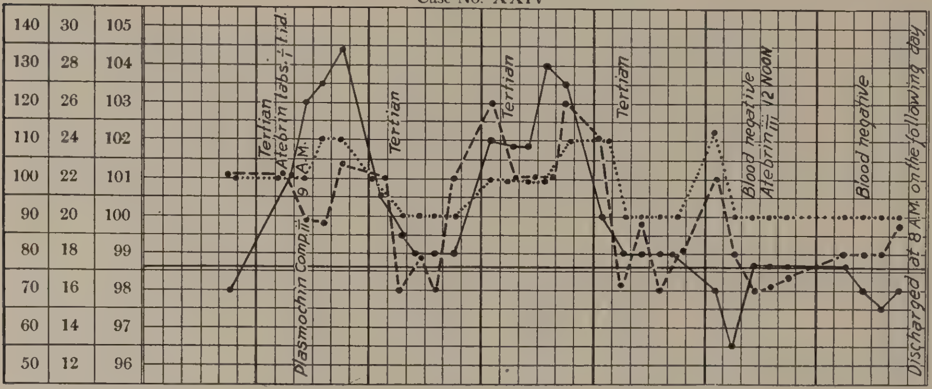

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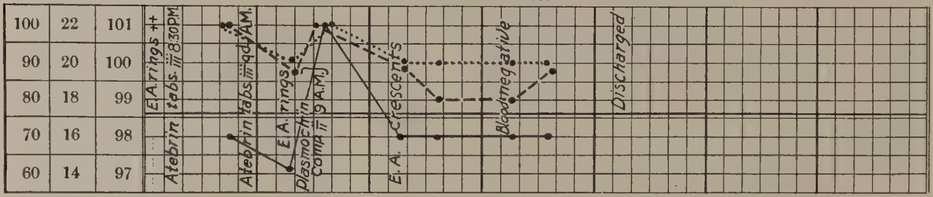

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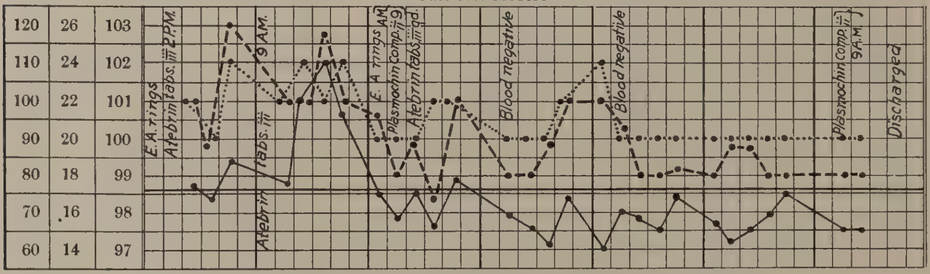

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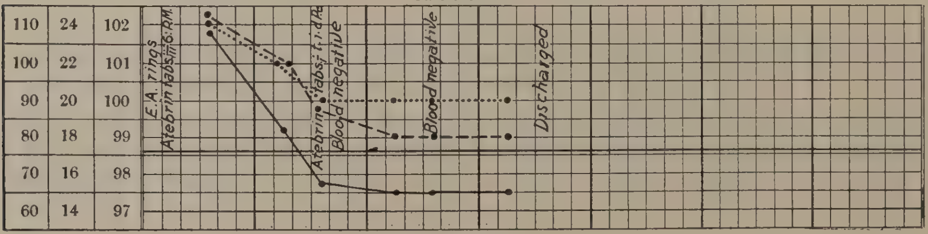

Nearly all of these patients lived in the port town. Those who returned for examination of the blood, after their course of treatment with Atebrin, were found free from parasites; and there were no complaints of ill effects from the drug. It is presumed that those who did not return were also free from symptoms; as there is no other place in the town where medical attention can be obtained, and treatment for malaria is furnished at the Dispensary to all residents, free of charge. A few cases returned after 2 or 3 days of home treatment without improvement. They were admitted to the hospital for better care, and reacted promptly to the usual treatment; so that the total amount of Atebrin required for complete relief was not essentially different from that of cases treated entirely in the hospital.

One of the Dispensary cases was treated for E. A. malaria with a total of 2.6 grams of Atebrin (0.3 gram daily) and 0.01 gram of plasmochin in one dose, with the usual excellent effect. Exactly 3 months after his last dose of Atebrin, he reported to the clinic again with fever; but this time the blood examination showed an infection of benign tertian malaria. He was then given another treatment, and was entirely free of parasites and apparently cured after he had taken 9 tablets of Atebrin.

HEMOGLOBINURIC FEVER

Hemoglobinuric fever induced by Atebrin treatment alone was not observed in our series of cases. The evidence is deemed insufficient, at present, to state that this may not occur. Five cases of hemoglobinuric fever have been treated during the past few months. All of the patients had taken quinine before admission. They were given different sized doses of Atebrin during the course of their illnesses; and no ill effects from the drug were noted. The data on these cases are as follows:

CASE NO. 1

A. G., Honduranian, male, 22 years of age; admitted December 8th; discharged December 20th.

History of present illness.—Had fever several days; took 30 grs. quinine daily for 2 days. Four years ago, he had had blackwater fever.

Physical examination.—Poorly nourished and anemic. Spleen enlarged one finger's breadth below the costal margin; no fever; pulse normal.

Laboratory findings.—Urine: normal on admission; blood, negative for malaria; stool: ova of ankylostoma, ascaris, and trichocephalus dispar.

Developments.—Patient was given 0.3 gram of Atebrin on the evening of admission. During the night, he had a rise of temperature to 101°F. Urine examination showed hemoglobin ++, and was also positive for quinine and Atebrin. Blood was negative for malaria parasites; hemoglobin, 35%.

Therapy.—Caffeine; Murphy drip of saline solution; and adrenalin by mouth. The temperature subsided to normal in the afternoon; and remained normal until the 7th day, when it rose again to 103°F., without obvious cause. The urine was negative for hemoglobin from the 3rd day. From the 8th day until the date of discharge, the temperature was normal. Atebrin was given as follows: on the 7th day, 0.1 gram; on the 8th day, 0.2 gram; and on the 9th day, 0.3 gram—which dose was continued to the date of discharge, without untoward effect.

CASE NO. 2

S. A., Honduranian, male, 23 years of age; admitted September 13th, 1931; discharged October 12th, 1931.

History of present illness.—Suffering from fever for quite a long time. No medicine had been taken. Was in the hospital, in 1930, for malaria.

Physical examination.—Poorly nourished and very anemic. Organs apparently normal. Temperature, 101°F.

Laboratory findings.—Blood: a few tertian parasites; hemoglobin, 30%; urine: albumin (slight trace) and a few granular casts; stool: ova of ankylostoma.

Developments.—On admission, and daily for the next two days, the patient received plasmochin compound, 0.02 gram, and 2 Pink Tonic Tablets* twice a day. On the evening of the 3rd day (September 15th) he had a chill and rise of temperature, with vomiting and hemoglobinuria. Blood was negative for malaria.

Therapy.—Murphy drip of saline solution, caffeine and glucose solution. For two days, the hemoglobinuria persisted (September 16th and 17th). He had an irregular temperature, up to 104°F., for several days. Atebrin was given as follows: on the 5th day (September 17th), 0.1 gram; on the 6th day, 0.3 gram; on the 10th day (September 22nd) and up to the date of discharge, regular daily doses of 0.3 gram of Atebrin supplemented with tonic doses of Fowler's solution or sodium cacodylate. Atebrin had no apparent influence on the fever, nor on the restitution of the hemoglobin in the blood. The patient's hemoglobin on discharge was 35%.

CASE NO. 3

L. F., Spaniard, male, 29 years of age; admitted, January 12th; discharged, January 22nd, 1932.

History of present illness.—Stated that he had been sick for 4 days with fever, and 2 days with blackwater. He had taken eight tablets (40 grs.) of quinine within 4 days.

Physical examination.—Poorly nourished, but apparently not very ill. Spleen enlarged 3 fingers below the costal margin. Hemoglobin, 70%; no fever.

Laboratory findings.—Blood, negative for malaria; urine, hemoglobin +.

Treatment.—Atebrin 0.2 gram daily.

Developments.—Urine cleared up two days after admission, and continued normal up to the date of discharge.

CASE NO. 4

P. M., Honduranian, male, 20 years of age; admitted, January 14th; discharged, February 5th, 1932.

History of present illness.—Fever for 2 days; blackwater for one day. On the day before admission to the hospital he took 20 grs. of quinine.

Physical examination.—Fairly well nourished, very weak, marked jaundice. The spleen was enlarged one finger below the costal margin. Vomiting was persistent. Temperature, 101°F.

Laboratory findings.—Blood: negative for malaria; hemoglobin, 55%; urine: hemoglobin ++.

Treatment.—Caffeine on admission; Atebrin, 0.2 gram, the day after admission.

Developments.—The temperature rose to 105°F. Patient was very restless and semiconscious.

Therapy.—Digitalis; caffeine; glucose intravenously and by Murphy drip. The temperature was normal on the 4th day. The urine was negative for hemoglobin, on the 5th day. Atebrin was given regularly from the 9th day to the date of discharge, without ill effect.

CASE NO. 5

F. M., Honduranian, male, 20 years of age; admitted, January 15th; discharged, February 10th, 1932.

History of present illness.—Fever for 7 days; blackwater for one day. He had taken 30 grs. of quinine daily for 3 days.

Physical examination.—Well nourished. Temperature, 101°F. The spleen was enlarged 3 fingers below the costal margin.

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* Pink Tonic Tablets each contain: 2 grs. quinine sulphate, 1/50 gr. arsenous acid, 1/8 gr. ext. nux vomica, 3/4 gr. reduced iron.

Laboratory findings.—Hemoglobin, 70%; blood, negative for malaria; urine, hemoglobin +++.

Treatment.—Caffeine, digitalis, glucose.

Developments.—Urine, negative for hemoglobin on the 3rd day. Atebrin was given as follows: on the 3rd day, 0.1 gram; and from the 4th day to the date of discharge 0.2 gram daily, without ill effects.

ATEBRIN IN THE TREATMENT OF CHILDREN

Eight children were treated with Atebrin. The following table shows the ages and the doses given.

Case	Age	Infection	Free of Parasites After .... gm. Atebrin	Free of Fever After .... gm. Atebrin	Daily Dose	Total Dose
A.	2½	E. A. +	0.4	0.2	0.1	0.7
B.	4	Tert. +	0.8	0.5	2 × 0.1	0.8
C.	11	E. A.‡	0.2	No fever	2 × 0.1	0.8
D.	8	E. A.	0.4	0.2	2 × 0.1	1.2
E.†	10	Tert. +	*	0.4	0.2	2.4
F.	3	E. A.‡	*	0.2	0.1	0.6
G.	8	E. A.‡	*	0.4	0.2	1.2
H.	5	E. A.	*	0.2	0.1	0.6

‡—Crescents appeared and were controlled by supplementary doses of plasmochin.
* These cases were treated in the out-patient department. No daily blood control.
† This patient had been treated with quinine for severe malaria on several previous occasions.

No untoward symptoms attributable to Atebrin were noted during the course of the treatment.

ATEBRIN IN CAMP TREATMENT

Twenty-one adults and six children (not included in our series of observations) were treated with Atebrin, in one of our labor camps, subsequent to a malaria blood survey. It is reported that the treatments were administered without difficulty. Owing to the fact that it is necessary to administer Atebrin but once a day, and that the tablets are smaller than those of quinine and only half as many are administered daily, the new treatment proved very convenient to the laymen administering the treatments. Doses for the adults were standardized at 3 tablets once a day for six days. For the younger children, the Atebrin was prescribed as a powder mixed with sugar of milk to provide the necessary bulk. When sufficient time has elapsed, another survey of the camp will be made to ascertain the efficacy of this method of treatment as compared with that of the quinine and plasmochin treatments used previously in camp treatments of malaria.

CONCLUSIONS

1. Atebrin, in daily doses of 0.3 gram for 6 days, is an efficient therapeutic agent in clearing the blood of the vegetative forms of benign tertian or malignant tertian (E.A.) malaria. It successfully and promptly relieves the symptoms of malaria. It may be used in smaller doses, but the treatment is more prolonged.

2. The toxicity of Atebrin is low, with a wide margin of safety between the effective therapeutic dose and the toxic dose.

3. Treatment with Atebrin has decided advantages over that with quinine. There is no tinnitus; digestive organs are not upset; and the tablets are small and very soluble, thus giving assurance that the medicine can be taken and that prompt absorption will follow.

4. Atebrin seems to have no destructive effect on the gametes in the blood and, for this reason, it should be supplemented with plasmochin.

5. Photosensibility does not occur; but a yellow discoloration of the skin may result, and especially if the treatment is extended over 6 days.

6. Hemoglobinuria does not seem to be provoked by Atebrin; nor does there seem to be any contraindication to giving Atebrin to cases which have developed hemoglobinuria.

7. It is our impression that relapses do not occur over a period of months following the completion of Atebrin treatment.

MALARIA CONTROL IN BANES, CUBA

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United Fruit Company Hospital

Banes, Oriente, Cuba

The control of malaria in Banes has progressed satisfactorily from the year 1926, when a definite attempt at control was begun. We herewith submit a discussion of the progress made up to the end of the year 1931, with comments upon some of the obstacles encountered and variations made in the measures used.

At first, malaria control measures were based mainly on: (1) elimination of water collections, where possible, through drainage and filling, or treatment of them with Paris green-dust mixture and oil; and (2) the wholesale distribution of quinine as a prophylactic. The treatment of malaria was based entirely on the use of quinine alone.

About 1926, Plasmochin was introduced; and was tried out at the Banes Hospital by using different dosages for varying periods of treatment. Its marked action on the sexual forms of the parasite was observed. It was also observed that large doses were liable to cause toxic symptoms such as cyanosis, intestinal colic, etc.; and similar observations have been reported by others. About 1928, the writer experimented with the small doses now in general use; and obtained very gratifying results. (cit. #1)

In 1930, changes were made in our measures of control, as follows:

(1) Due to present economic conditions, the work of eliminating bodies of water by filling or draining has been restricted to a minimum.

(2) The use of oil as a larvicide has been practically eliminated; and our mosquito control, which was always limited to short-radius control about habitations, now depends almost entirely on the use of the Paris green-dust mixture.

(3) Whereas two anti-mosquito squads were formerly operating, we now use only one, which is composed of four men and a foreman; and, whereas the squads worked formerly on a fixed schedule so as to cover the area of some 40,000 acres at short intervals, this squad now travels with the Malaria Inspector as he goes from camp to camp doing blood surveys.

(4) The education of the people, with regards to prophylactic and sanitary measures and the treatment of malaria, has been intensified.

(5) All patients attending the Dispensaries have their blood examined systematically for malaria parasites, regardless of the condition for which they seek treatment.

(6) Frequent blood-surveys are made in active areas; and re-examinations of those once found infected are made several times during the year.

(7) An individual record is kept of each case occurring in the Division; whether a Hospital case, a Dispensary case, or a case found in the surveys. Such cases are given quinine and plasmochin treatment for as long a period as possible, up to two or three months. (cit. #1)

(8) Efforts have been made by the Company to stabilize labor, with the new colonization scheme which began in the latter part of 1929 and the stimulation of plantings in the bateys or camp areas so as to increase the supply of green foods.

The results obtained are synoptically described in the following tables:

TABLE I

Malaria Case Percentage of Total Hospital Admissions; Survey Percentage; Average Rainfall

Year	Patients Admitted to Hospital	Malaria Cases Admitted	Percentage	Malaria Survey Percentage	Average Rainfall
1926	3,693	2,330	59.04%	38.70%	54.23
1927	2,149	772	35.92%	24.3%	37.92
1928	1,730	323	18.67%	22.3%	45.37
1929	1,893	292	19.95%	No surv.	34.38
1930	1,538	114	7.41%	.88%	42.05
1931	1,427	164	11.40%	.30%	62.42

Table I shows a progressive decline in the number of cases of malaria admitted to the Hospital from 1926 to 1930. It also shows a slight rise in 1931 over 1930, in the total number of malaria cases admitted and in the percentage of cases compared to total admissions; although it records, in 1931, a drop in the malaria survey rate as compared with previous years. This apparent contradiction may be explained by the fact that the total increase of malaria cases, which occurred in 1931 as compared with 1930, is in ratio to the increase in rainfall and reflects the greater influx of infected migrant labor; whereas the survey percentage was obtained in the month of December (several months following the end of the crop season), when stabilization of labor conditions in the Division had reached a peak.

Operations in a sugar-mill plantation trace a curve of labor migration more or less as follows: Just before the beginning of the crop, towards the end of December, cane-cutting and other migratory labor begins to enter the Division in large numbers; and many of these individuals are infected with malaria. This influx continues until the crop is fully established, when the Division becomes plethoric with labor. The crop season may last from three to six months, but usually extends from January to April or June; and, at its termination, the transient labor gradually leaves the area until, by September or October, the stabilization of labor is complete. The influence of this labor migration curve is evidenced in the fact that the highest peak of our malaria curve always occurs towards the end of March, when the full complement of migrating labor has arrived; and the line of the curve gradually descends towards the latter months of the year. Thus, Table II, shown below, gives a total of 580 cases occurring in the Division during the seven months period from January to July, 1931, with 148 (27.20%) admissions to the Hospital; as compared to 211 cases during the five months period from August to December, with 16 (7.50%) admissions to the Hospital.

TABLE II

Cases Occurring in Each District During 1931, Divided into Two Periods; and Showing the Percentage Sent to Hospital in the Corresponding Periods

	Seven Months Period—January to July			Five Months Period—Aug. to Dec.		
Districts	No. of Cases	Cases Admitted to Hospital	Percentage Admitted	No. of Cases	Cases Admitted to Hospital	Percentage Admitted
Dist. #I.	200	11	5.50%	58	3	5.17%
Dist. #II	176	33	18.70%	68	2	3.00%
Dist. #III	184	94	51.00%	84	11	13.00%
Dist. #IV	20	10	50.00%	1	—	—
Grand Total . . .	580	148	27.20%	211	16	7.50%

This labor migration will always constitute a problem in the attempts at complete eradication of malaria in the area. A large percentage of this migrating labor is made up of Haitians, among whom the incidence of malaria is very high.

Tables III, IV and V compare, chronologically and otherwise, our cases occurring during 1930 and 1931. The total number of bloods examined during 1930 was 7,275; with 403 positives, or 5.50%. In 1931, there were 12,493 bloods examined; with 791 positives, or 6.33%.

The incidence of malaria is observed to be greater among adults; which must, of course, be attributed to the adult labor migration.

TABLE III

Malaria Cases Among the Various Labor Groups

Districts		1930							1931						
		Cubans	Jamaicans	Haitians	Others	Total	Grand Total	Percentage Positive	Cubans	Jamaicans	Haitians	Others	Total	Grand Total	Percentage Positive
Dist. #I	Adults	106	2	19	—	127			113	13	64	—	190		
	Children	24	2	4	—	30	157	38.95%	59	4	5	—	68	258	33.51%
Dist. #II	Adults	93	—	11	—	104			144	9	46	2	201		
	Children	17	1	3	—	21	125	31.01%	36	3	4	—	43	244	31.74%
Dist. #III	Adults	95	—	5	—	100			175	15	16	1	207		
	Children	10	3	2	—	15	115	28.53%	53	6	1	1	61	268	35.27%
Dist. #IV	Adults	5	—	—	—	5			15	—	—	—	15		
	Children	1	—	—	—	1	6	1.48%	6	—	—	—	6	21	2.60%
Totals	Adults	299	2	35	—	336		83.37%	447	37	126	3	613		77.49%
Totals	Children	52	6	9	—	67		16.62%	154	13	10	1	178		22.50%
		351	8	44	—	403			601	50	136	4	791		

TABLE IV

Malaria Cases by Farm Areas

Districts	Farms	Years	
		1930	1931
District #I	Calabazas	89	103
	Deleite	38	68
	Naranjo Dulce	19	56
	Entronque	11	31
	Totals	157	258
District #II	Pilon	67	115
	Caimana and 400 Rosas	15	53
	Negritos	17	34
	Lindero	26	42
	Totals	125	244
District #III	Macabi (Mill)	17	12
	4 Veredas and Veguitas	13	33
	Tasajeras	26	41
	La Raya	18	77
	Jagueyes (Including Banes and Embarcadero)	41	105
	Totals	115	268
District #IV	Los Angeles	6	21
Grand Total		403	791
Total Blood Examinations		7,275	12,493
Percentage Positive		5.50%	6.53%

In Table IV the cases are distributed according to the various agricultural districts or farms; and it shows that District IV, which is the area of highest altitude, has an insignificant number of cases compared with the other Districts. Calabazas and Pilon Farms, which extend over a region of comparatively low altitude, show the highest number of cases—with the exception of Jagueyes, in 1931.

Table V

Malaria Cases—Percentage Admitted to Hospital

	1930				1931			
Districts	Hospital Admissions	Dispensary Cases	Total	Percentage	Hospital Admissions	Dispensary Cases	Total	Percentage
Dist. #I	12	145	157	7.64%	14	244	258	5.43%
Dist. #II	36	89	125	28.80%	35	209	244	14.34%
Dist. #III	60	55	115	52.17%	105	163	268	39.10%
Dist. #IV	6	0	6	100%	10	11	21	47.60%
Grand Total	114	289	403	28.20%	164	627	791	20.70%

It will be observed that the highest percentage of cases admitted to the Hospital, as compared to the total number occurring, were from Districts III and IV. This is due to the fact that the Hospital is located in the centre of this area, and that medical field work is not as intensive there as in Districts I and II.

The Rôle of Plasmochin

The study of the effects of Plasmochin, made by Whitmore, and by Barber and Komp (cit. 2), seems to show that this drug, given in small doses, so affects the gametocytes as to make them non-infective even when their destruction or disappearance from the peripheral circulation is not immediately forthcoming. As a result of their experiences; all malaria cases in the Division have been treated since 1930 with both quinine and plasmochin, as reported last year (cit. I).

Further, in Districts I and II, where the incidence of malaria had always been high before 1930, plasmochin was used as a prophylactic in the following manner: In any residence where one or more cases of malaria were found, the routine malaria treatment was given to the afflicted individuals; and the other dwellers therein were given one centigram of plasmochin daily for four days. During 1931, this method was changed; and we have been giving only two centigrams of plasmochin as a prophylactic, but have extended the treatment to include the whole population of the camp. It is our impression that this procedure has been effective, as the number of cases and the severity of the attacks have been reduced. Such prophylactic procedure has not been employed in Districts III or IV, where the endemic has always been lightest, but they have been used as control areas.

During the months of August, September, October and November, 1931, seven camps in Pilon Farm, District II, where the greatest number of cases had occurred during the crop period, were selected for special surveys; and blanket treatments of plasmochin were given to all those present at the time of the inspection. The results are shown in Table VI below.

TABLE VI

Special Surveys—1931

Name of Camp or Unit	First Survey August and September			Second Survey September and October			Third Survey October and November		
	Bloods Taken	Positives	Percentage	Bloods Taken	Positives	Percentage	Bloods Taken	Positives	Percentage
Pedregal	108	5	4.63%	100	1	1%	71	1	1.40%
Pilon Batey . . .	125	3	2.40%	94	1	1.06%	90	0	0
San Sebastian . .	90	5	5.55%	87	0	0	82	0	0
Antillita	78	5	6.41%	78	1	1.28%	74	0	0
Desengaño . . .	66	0	0	78	1	1.28%	85	0	0
San Antonio. . .	60	2	3.33%	79	0	0	75	0	0
Punta Alegre . .	51	6	11.76%	43	4	9.30%	40	0	0

This table shows that 26 persons were found positive during the first survey. While this survey was taking place, two centigrams of plasmochin were given to each individual in the camps. This procedure was repeated in the two subsequent surveys, which were made at intervals of five weeks.

Of the eight individuals found positive in the second survey, two were new cases. One of these cases had been negative on the first survey (Desengaño case); but had been treated for malaria previous to these special surveys, and was probably a relapsing case. The other one (Antillita case) had not taken treatment nor had his blood examined during the first survey.

On the third survey, only one positive was found; and this patient had been positive during all three surveys, being one of those individuals who can hardly be persuaded to take proper treatment.

In a later general survey, made in the Division during the month of December, all of these cases were examined and were found negative. In this survey, 1,000 bloods were taken and only three were found to be positive—two from District III and one from District IV.

James (cit. #3) observed, in a series of experiments, that several cases, who were given a dose of plasmochin of 2 centigrams the day before infection and the same dose for six consecutive days following infection, did not develop the disease; while other cases, who were not given this prophylactic treatment, contracted the disease when bitten by an infected mosquito.

Considering these experiments and observations, one is led to believe that plasmochin is a powerful aid in malaria-control work. The optimum length of time during which it must be administered, and the minimum dose required, have not been definitely determined; but pending a final answer to these questions, I have reached the tentative conclusion that, in a locality where active transmission is taking place, the incidence of the disease can be materially reduced by (a) routine malarial treatment of all positive cases and (b) administration of two centigrams of plasmochin weekly, for a period of five weeks, to all inhabitants.

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THE RÔLE OF PLASMOCHIN IN SANITATION

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This article should be considered as Part II to the paper by the author which appeared in the Annual Report of the Medical Department of the United Fruit Company for 1930, as it is distinctly supplementary to that paper.

In this article is outlined the procedure adopted during 1931 for the purpose of studying further the efficacy of Plasmochin and determining its true value as a prophylactic agent.

The Panama Division was without the services of a Local Sanitary Inspector from September 10th, 1930, until February 12th, 1931. During that time (in October and November, 1930), a malaria survey was made of the entire Division, following a blanket treatment of quinine and plasmochin which was administered to many non-employees in addition to all of the employees and members of their families. The results of this survey, which have already been described in the Annual Report for 1930, are repeated in the first three columns of Table I for purposes of comparison.

General Sanitary Inspector Carleton Hale visited the Panama Division from January 16th, 1931, to January 29th, 1931; and, after his inspection, suggested that we try a blanket treatment with Plasmochin Compound alone (without additional quinine) as he had been rather impressed with the results that Plasmochin had evidently accomplished—which results had been described, as indicated above, in the 1930 Annual Report. This blanket treatment was accordingly begun early in March, 1931; and consisted of giving weekly to all people living in unscreened houses in the Division one tablet of Plasmochin Compound containing quinine .125 gram and Plasmochin .01 gram. The dosage was modified for children. After the drug had been administered thus for four weeks, the first semi-annual malaria survey for 1931 was made of the entire Division, during which each person was given again one tablet of Plasmochin Compound at the time that each thick blood film specimen was taken. The results are recorded in columns 4, 5 and 6 of Table I.

TABLE I

	Survey—1930			First Survey—1931			Second Survey—1931		
Name of Camp	Total Examined	Positives	Per cent. Positive	Total Examined	Positives	Per cent. Positive	Total Examined	Positives	Per cent. Positive
Farm 4	72	7	9.72	102	9	8.82	50	9	18.00
Farm 10	65	6	9.23	150	15	10.00	175	34	19.42
Farms 8, 9 and Base Line	115	12	10.43	127	14	11.00	137	50	36.49
Farms 2 and 3	148	13	8.78	128	24	18.78	88	27	30.68
Farms 1, 5 and 6	151	15	9.93	131	18	13.74	137	30	21.89
Guabito	174	22	12.64	206	20	9.70	219	30	13.69
California	85	8	9.41	87	9	10.34	74	14	18.91
San San	90	9	10.00	114	18	15.78	100	15	15.00
Isla Grande	26	3	11.53	34	3	8.82	58	3	5.17
Barranco	50	5	10.00	57	7	12.28	52	7	13.46
Nievecito	31	2	6.45	25	4	16.00	42	7	16.66
Dos Canos	67	13	19.40	79	15	18.98	85	8	9.41
Elena	70	6	8.57	48	3	6.25	75	12	16.00
Sibubi and Senosri	83	6	7.22	96	9	9.37	88	11	12.50
La Palma	20	3	15.00	18	2	11.11	24	3	12.50
Virginia	74	11	14.86	50	8	16.00	89	15	16.85
Sixaola Banana Co.	70	13	18.57	74	11	14.86	54	6	11.11
Costa Rica Farm	48	3	6.25	47	8	17.02	45	5	11.11
La Celia	26	2	7.69	—	—	—	30	5	16.66
Daytonia	67	10	14.92	66	14	12.21	46	7	15.21
Zavala	14	1	7.14	—	—	—	—	—	—
Favorita	—	—	—	16	4	25.00	17	2	11.76
Paraiso	49	4	8.16	54	9	16.66	55	7	12.72
Catarina	39	3	7.69	51	7	13.72	75	8	10.66
Margarita	53	6	11.32	49	9	18.36	80	14	17.50
Olivia	30	2	6.66	41	5	12.19	54	8	14.81
Feilds	43	7	16.27	39	11	28.20	50	13	26.00
Chase	92	8	8.69	119	14	11.76	133	14	10.52
Totals	1852	200	10.79	2036	275	13.50	2132	364	17.07

At the suggestion of Dr. R. C. Connor, General Manager of the Medical Department, we increased our weekly dosage of Plasmochin in our next blanket treatment; which was begun early in July, 1931, and which we carried through for six weeks, giving to each individual two tablets of Plasmochin Compound each week with the dosage modified for children. As in the first Plasmochin blanket treatment, the foremen of the various labor and farm gangs dispensed the drug themselves to all employees and members of their families. Six weeks after the blanket treatment was completed, the second semi-annual malaria survey for 1931 was begun. Each individual received two Plasmochin Compound tablets at the time that the blood specimen was obtained. The survey was completed November 21st, 1931; and the results obtained are detailed in columns 7, 8 and 9 of Table I.

In Base Line, San San, Dos Canos, Farm 4 and Favorita, schools are situated; and in each survey the children were examined along with the remainder of the population. It should be explained that some of the school children were in attendance daily from other districts than those mentioned above, thus increasing the proportion of children in these communities at the time of the survey. Due to the abnormally high percentage of children, under such conditions the rates for these camps are undoubtedly higher than would be recorded if only the permanent population of each locality were taken.

After the first 1931 survey, all cases found positive were treated for six days. Adults and adolescents from 12 years up received two 5-grain tablets of quinine twice a day, and one tablet of Plasmochin Compound once a day; while the dosage for children under 12 years of age was modified according to their ages. After the second 1931 survey, all positives were treated in a similar manner for 12 days. It is important to add that the overseers or foremen themselves dispensed these drugs on all of the farms, and that the patients were required each time to take the medicine in their presence. In our earlier experiences in the treatment of positives, when each individual was allowed to take the medicine home with him to be taken according to directions, it was found in the house-to-house inspections of the Local Sanitary Inspector that in about fifty per cent. of the cases the drugs were never touched. The patients, when questioned, admitted that they were merely saving the tablets until such time as they might have an attack of fever.

It is also important, in making the comparisons of the different surveys, to bear in mind that all three were conducted by the same individual. When all the Divisions are having their local technicians conduct their surveys, greater differences are apt to be found among the different units than would be the case were the same individuals conducting the malarial surveys in all of the Divisions. At best, surveys cannot possibly offer an accurate malarial index; for it is only too well known that a specimen of blood from an individual may be found positive one day and another specimen taken the following day be found negative, and vice versa. A survey wherein thick films might be taken of all individuals in a given community for three consecutive days would, if carefully examined, give a reasonably true index of the malaria rate in that locality. Furthermore, the personal factor must be considered—i.e., some technicians are far more keen and alert than others, and all do not devote the same length of time to the examination of their slides. Moreover, as many of the population as is possible should be examined in each locality; as it is always easy to raise the percentage of positives by examining mainly the children.

It will be noted that (a) the *first survey* was made two months after the services of the Local Sanitary Inspector had been discontinued, and directly after a divisional blanket treatment of quinine and Plasmochin; (b) the *second survey* was begun two months after the services of a keen Local Sanitary Inspector were secured, and directly after a four-week divisional blanket treatment with Plasmochin Compound in small doses without supplementary quinine; and (c) the *third survey* was conducted after the Division had had the benefit of eight months of continuous services of a trained Local Sanitary Inspector, and six weeks after a divisional blanket treatment of Plasmochin Compound dispensed in larger dosage but not supplemented by quinine.

Table II records the monthly rainfall for 1930 and 1931, as these data may be of some interest in connection with a comparison of the rates of infection observed during the three surveys:

TABLE II

Month	Rainfall (Inches)	
	1930	1931
January	2.73	9.91
February	1.01	2.10
March	2.88	14.33
April	3.78	8.16
May	8.68	7.84
June	6.31	9.13
July	21.33	8.15
August	20.25	10.34
September	9.71	5.39
October	2.43	3.23
November	4.92	5.22
December	7.34	10.13
Totals	91.37	93.93

We noted during 1931 that, even though the malarial index was found by the surveys to be rather high in places, all of the positive smears showed distinctly mild infections. (This accorded with our experiences in 1930, which were reported in the 1930 Annual Report.) Not one even moderately heavy infection was found among the survey slides; and the laboratory technician reported that not one of the persons examined showed any signs of active fever, as had been so common during the surveys of several years ago. Of the dispensary and hospital thick film examinations during the year, only 14 out of 285 were reported as moderately heavy infections and only 11 as very heavy infections.

The general reduction of the morbidity rate, and its ratio to the reduction in the malaria rate, is shown in Table III:

TABLE III

Year	Total No. of Employees	Total No. of Hospital Admissions	No. of Admissions of Employees	Total No. Positive for Malaria (Primary Diagnosis)	Employees Positive for Malaria (Primary Diagnosis)	Total No. Positive for Malaria (Secondary Diagnosis)	Employees Positive for Malaria (Secondary Diagnosis)
1925	3312	2999	2208	1007	763	246	199
1926	3092	2802	1970	694	510	314	250
1927	2804	2170	1479	441	310	111	85
1928	2690	2390	1584	507	323	90	65
1929	2551	1721	1087	295	178	53	41
1930	2346	695	439	140	96	69	47
1931	2214	695	498	106	82	59	43

In the 1930 Annual Report, reference was made to the unaccountable but simultaneous reduction in the general morbidity rate which followed the reduction in the malarial rate. This general morbidity rate continued low throughout

1931, in spite of epidemics of influenza, pertussis, measles and varicella which occurred in the Division. Furthermore, we might have expected a rather substantial increase in malaria in the Panama Division during 1931; as a fairly large number of Nicaraguans and other Latin Americans of the mestizo type entered the locality and secured employment with the Company at various times throughout the year, and these races do not resist malaria nearly as well as the negroes and mulattoes who comprise a large percentage of our stabilized labor force. However, this anticipated increase did not materialize; as may be observed by reference to Table III, and to Table IV which shows the general morbidity rates, the hospitalized cases of malaria, and the malaria fatality rates for recent years.

TABLE IV

Year	No. of Employees	Average Daily Hospital Census (All Cases)	Hospital Malaria Cases (Employees)	Fatal Cases of Malaria (Employees)	Fatality Rate Per Thousand
1925	3312	102.37	1007	8	7.9
1926	3092	90.69	694	10	14.4
1927	2804	84.94	441	6	13.6
1928	2690	87.74	507	3	5.9
1929	2551	62.16	295	4	13.6
1930	2346	21.08	140	3	21.4
1931	2214	21.61	106	1	9.4

The distribution of hospital cases of malaria throughout the year 1931, as compared with the hospital admissions for all causes, is shown in Table V:

TABLE V

Month	Total Number of Hospital Admissions	Number of Malaria Cases Admitted to Hospital
January	42	13
February	52	8
March	70	15
April	52	9
May	50	7
June	54	10
July	63	20
August	54	15
September	73	20
October	49	13
November	50	14
December	86	21

Haemoglobinuric Fever.—In my article in the 1930 Annual Report, attention was called to the tendency for cases of haemoglobinuric fever to increase where quinine prophylaxis was practiced; and I described the increase that occurred that year, attributing the misfortune to the quinine and Plasmochin blanket treatment that had been administered. I consoled myself by the fact that these blackwater fever cases were accompanied by a very low death-rate, because they were mainly of the type which is most probably provoked by medication; and stated that I felt justified in continuing our blanket treatments, in view of the fact that it reduced the general morbidity through its effect on the malarial rate and that the blackwater fever cases induced by it were always of the milder types. In 1931, quinine was used only for treatments; and was not administered for prophylactic purposes, with the exception of the small amount contained in the Plasmochin Compound formula. Whether this made a difference, or some other factor still unknown or unrecognized exerted some influence in the establishment of this phenomenon, is hard to say; but it was gratifying to observe that, despite the two divisional Plasmochin Compound blanket treatments mentioned herein and the extensive treatments of all positives, there was a marked decrease in haemoglobinuric fever during 1931. This is shown in Table VI.

TABLE VI

Year	Total Hospital Admissions	Malaria Cases—Primary and Secondary Diagnosis	Blackwater Fever Cases—Primary and Secondary Diagnosis	Deaths from Blackwater Fever
1925	2,999	1,253	9	3
1926	2,802	1,008	4	2
1927	2,170	552	4	0
1928	2,390	597	7	1
1929	1,721	348	7	0
1930	695	209	15	1
1931	695	165	5	1

In the report of the preceding year several cases of haemoglobinuric fever were cited, chiefly for the purpose of describing the different types of cases and to offer convincing evidence that Plasmochin is no more prone to excite the production of haemoglobinuria than is quinine. The following case report is another which offers an illustration that Plasmochin is frequently tolerated better than is quinine by cases suffering from this obscure syndrome-complex.

CASE REPORT

A young, male, Nicaraguan mestizo, aged 23, was admitted to the Hospital on October 1st, 1931. He complained of having had fever for eight days, with chilly sensations and headaches but no cough or vomiting.

Physical Examination.—The patient was well developed but rather undernourished, with apparent anemia, weakness, and sallow skin; conjunctiva was pale, but eyes were otherwise negative; ears, nose and throat were negative; no glandular enlargements; lungs, negative. Heart showed a hemic murmur at base, but not transmitted; no enlargement; beats, weak and rapid. Spleen was enlarged, and extended two finger breadths below the costal border. Abdomen was otherwise negative. Definite tenderness was elicited over the kidneys. Temperature on admission was 99.6°F.; pulse, 116; respirations, 26.

Treatment.—Despite the fact that the thin blood smear was negative for parasites, 15 grs. of quinine and one Plasmochin Compound tablet were given with an injection of ten drops of adrenalin chloride on admission, after a thick blood film had been taken. The next morning, haemoglobinuria developed, accompanied by a temperature of 104°F.; pulse, 120; and respirations, 28. Quinine and Plasmochin were discontinued; and caffein sodium benzoate was injected and sodium bicarbonate given by mouth, while heat was applied to the kidneys. The thick blood film was reported as negative; the haemoglobin was 50%; and the stool specimen showed only trichocephalus. The temperature descended rapidly to normal; and the urine became clear on the 4th day in the Hospital.

Relapse.—On the 8th day of admission, despite two negative thick blood films and because of the generally conceded malarial etiological factor in this disease, quinine was administered by giving only 2½ grains three times a day. On the 11th day, the quinine was increased to 5 grains three times a day; and on that same evening the temperature rose suddenly from normal to 102°F., with a pulse of 100 and 22 respirations per minute; and, at the same time, there appeared a relapse of the haemoglobinuria. Sodium bicarbonate and the injections of caffein sodium benzoate were again administered; and both the fever and the haemoglobinuria had subsided entirely by the 13th day. Thereafter, one Plasmochin Compound tablet was administered three times a day, without producing any untoward effect whatsoever, until his discharge from the Hospital on the 25th day after admission.

CONCLUSIONS

1. Judging from the results of the three divisional malarial surveys, little advantage seems to have been gained from serious sanitary inspections and liberal treatment with Paris green dusting powder of all breeding places within short radius distance of farms, camps, and towns; although meteorological conditions must also be considered. In spite of this revelation, however, it would still seem too heroic a measure to abandon all malarial control methods, leaving Plasmochin alone to accomplish this through its so-called gametocidal properties.

2. The apparent gametocidal action of the Plasmochin; or, at least, its faculty for affecting the fertility of the gametes to the extent that the development of oocysts are inhibited, seems still to be the only explanation for the great reduction in the morbidity rate in the Panama Division. This has been discussed at greater length in the United Fruit Company's 1930 Annual Medical Report.

3. Although aware that the general concensus of opinion (as voiced at the meeting of the National Malarial Committee which met in Louisville, Kentucky, in November of 1930) seemed none too enthusiastic as regards the virtues of Plasmochin generally, even though it was conceded that it provoked an inhibitory action in the gametes on the development of oocysts, I have observed its therapeutic action so long and in so many cases that I heartily agree with those who acknowledge its adjuvant action to quinine.

4. Can the reduction of the haemoglobinuric fever incidence during 1931 be attributed to the fact that blanket treatments with Plasmochin Compound were instituted in the Division that year, in contra-distinction to the combined Plasmochin and quinine blanket treatments of preceding years?

MALARIA CONTROL MEASURES IN CHIRIQUI

M. D. ROJAS, M.D.

Chiriqui Land Company Hospital

Puerto Armuelles, R. of P.

Our former Sanitary Inspector of this Division, Mr. J. R. Maltsberger, published last year an interesting and complete article dealing with malaria control measures from the time the Company began operations on the Pacific coast of Panama. His article is entitled, "Interpretation of a Three-Year Malaria Curve in Chiriqui." It covers fully all the basic factors involved in this kind of work; viz.—topography, climate, and the social history of the region.

LABORERS' QUARTERS IN THE CHIRIQUI LAND COMPANY DIVISION

During the past year we have continued the same energetic anti-malaria measures; and have established certain routines that have accomplished gratifying results, and which I wish to outline simply as a supplement to the plan and measures described by our former Inspector, Mr. Maltsberger.

Anti-larval measures, and treatment of carriers apprehended by blood surveys, still continue to be the basis of our control program. This year we have devoted particular attention to the education of the inhabitants. We learned to realize that, without active cooperation on the part of the people, the work is only partially successful; and that it is a matter of time, effort and patience before the masses can be made to understand the benefits of such a campaign.

We take the opportunity, when gathering the people for our malaria surveys, to give short talks and explain in the simplest manner the ill effects of malaria infection and how to prevent and cure the infection. Pamphlets dealing with the subject of malaria are distributed to the better educated people. Field dispensers and sanitary men are instructed to explain to the people, in a practical way, the reason for sanitary work and why they should take the quinine whenever it is prescribed. It is gratifying to say that the people are beginning to realize the importance of the Company's effort to free them from malaria.

From 1928 to 1930, long range larval destruction was carried out in the vicinity of the towns and camps. In April, 1931, Mr. Carleton Hale, General Sanitary Inspector, arrived in the division and recommended that we should discontinue treating extensive areas not in the immediate neighborhood of habitations. He proposed a maximum of no more than 500 yards from towns or camps, and recommended that we concentrate our attention on anti-larval measures in the vicinity of the camps. This change has proved quite successful. Many small breeding places were neglected or overlooked before this change, owing to the fact that much time was spent treating breeding places too distant from the labor camps. We have prepared a general map of the Division, indicating the towns, labor camps, creeks or rivers, lagoons and canals. This map shows all the larger potential breeding places, which are now under control. The Sanitary Inspector and his gang work constantly for eight hours a day. He makes thorough examinations of the various places indicated on the map; and

RESIDENCES AND SWIMMING POOL OF FIRST-CLASS EMPLOYEES IN THE CHIRIQUI LAND COMPANY DIVISION also inspects the districts as a whole, in order to discover any additional actual or potential breeding foci not previously recorded. The location of breeding places varies considerably, of course, during the change from the dry to the rainy season and vice versa. Our personnel consists of a Sanitary Inspector and two men who follow him and carry the anti-larval material. All three men are well trained in recognizing anopheline larvae.

The sanitary gang inspects all potential breeding places twice a week, but treats only those which are actually breeding. The Inspector writes a report at the end of the week, detailing the places where breeding was found and how they were treated, and making recommendations for general clearing around camps and any other measures which are considered of importance to improve sanitation. Copies of his report are sent to the Division Manager, Medical Superintendent, Division Engineers, and Superintendent of Agriculture; and essential sanitary measures are given prompt attention. All sanitary work is under direct control of the Medical Department, and is checked up by semi-monthly inspections of the Medical Superintendent.

ANTI-MALARIA WORK IN THE CHIRIQUI LAND COMPANY DIVISION

Anti-larval Measures.—Paris green has proven most efficient. Most of our places are overgrown with vegetation, and are ideal for the use of Paris green. The mixture of 1 part of Paris green to 100 parts of sawdust and sand, which had been spread by hand, was discontinued by Mr. Hale on his last visit; and he substituted a mixture of 3 parts of Paris green to 100 parts of lime, to be spread by dust blowers (Italian type). This new mixture is finer and lighter; it gives an even distribution, and is easy to apply under the weeds; and has much greater larvicidal power. Petrolization of areas suitable for oil treatment is also accomplished by sprays; but there can be no question that the distribution of Paris green mixture by dust blowers is more effective and economical.

Malaria Surveys.—These are very important measures in our malaria control. The Port and all labor camps in the farms are systematically surveyed four times during the year. The thick film method is used. The overseer of a farm is notified one day ahead, so that he can have his people ready. He knows the working population of his district, including the members of the families of laborers; and we prepare sufficient slides for blood smears, according to his estimations.

INSPECTION FOR MOSQUITO LARVAE, AND APPLICATION OF PARIS GREEN

Practically 86% of the total population of the Division (around 4000) submit to blood tests four times a year. Three days after a survey, we know the number of infected people. Treatment of positives for a period of two weeks is then started by the local Dispenser, who sees that the people take their quinine and Plasmochin. The Sanitary Inspector checks the Dispenser, to see that treatment is properly carried out. The population of this Division is at present very stable; and this enables us to obtain more accurate knowledge of the percentage of infection and to treat more effectively those found to be infected.

Malaria control measures have reduced the incidence of malaria in this Division from 58.8% at the time that the development of the Chiriqui Land Company began in 1928, to about 8.6% in 1931.

The following table shows statistical data on malaria, dating from 1929 when the hospital was organized.

	1929		1930		1931	
	Emp.	Non-emp.	Emp.	Non-emp.	Emp.	Non-emp.
A. Hospital admissions:						
Estivo-autumnal	317	58	226	50	64	25
Tertian	133	19	236	48	89	35
Quartan	—	—	1	—	—	—
Mixed	—	1	1	1	2	2
Clinical	24	6	62	5	11	2
Cachexia	5	—	4	—	1	—
Hemoglobinuric fever	14	2	23	4	11	2
Totals	493	86	553	108	178	66
B. Census of population	3576	750	3409	1216	2158	1571
C. Admission rate per 1000	138	115	162	89	82	42
D. Death rate per 1000	1.7	5.3	3.2	2.5	1.4	.6

The following chart shows the results of the divisional survey completed August 13th, 1931. The total percentage of positives was about 9.5%, as compared with approximately 12% in 1930.

Place	Number Examined	Positives	Percentage
Blanco	309	45	14.56%
Corredor	202	28	13.86
Majagua	49	7	14.3
Caraña-Berba	188	17	9.
Esperanza	336	21	6.2
Pital	119	11	9.2
Cedro	84	10	11.9
Cuajada	98	9	9.18
Zapote	251	19	7.57
Silver City	433	27	6.2
Miramar	269	28	10.4
Totals	2338	222	9.5%

Careful study of two previous surveys in 1931 shows that at least 17% of the people who were found to be malaria carriers during those surveys are still positive, in spite of the fact that they received treatment for two weeks and the treatment was well supervised. The same thing holds true with hospital admissions, as frequently the same patients are admitted two or three times a year for malaria. As Dr. H. C. Clark has stated, it is difficult to harmonize the malaria parasite index in a community with the mosquito index of infection; and one is led to believe that new malarial infections form but a small part of the community index, and that most of the incidence is due to chronic cases and relapses.

As I stated before, our population is at present very stable, and accessible to extended periods of treatment; and, in consequence, it is hoped that the incidence of malaria in this Division will continue to decrease gradually.

MALARIA CONTROL MEASURES IN 1931

J. C. McDaniel, Technician

Tela Railroad Company Hospital

Tela, Honduras

It has been a long accepted fact that malaria constitutes a serious and constant menace to the health and progress of communities located in areas where the infection is endemic; and it must also be realized that no methods, regardless of cost and effort, have proved entirely successful in eradicating this disease in those extensive endemic areas where natural conditions throughout the year are suitable for the continuous propagation of Anopheles mosquitoes. While efficient sanitary control is the most effective means of eradication known at present; such measures could never be carried out successfully over the vast tropical plantation areas with which we have to deal, without incurring expenditures which are prohibitive.

From our earliest operations, we have utilized some system of sanitary control in our various Divisions; but it was entirely inadequate to meet the urgent demand for satisfactory control measures at a moderate cost. Consequently, in our efforts to effect a control that would materially reduce sickness, and increase labor efficiency and earning power, we have adopted the plan of making routine blood examinations of all inhabitants in camps and treating all those found positive for malaria. In the following table we have inserted data on the malaria rates which were prevalent in the Tela Division a few years ago, as recorded during blood surveys made at that time; and, for the purpose of comparison, have shown in the last column the rates of infection in corresponding camps as revealed by the surveys made during 1931:

	Data Regarding Initial Surveys in 1923, 1924 and 1925				Last Survey—1931
Farm	Date of Survey	No. of People Examined	No. Positive	Percentage Positive	Percentage Positive
P. Arturo	1–13–23	111	70	63.0	2.2
9	10–21–24	28	16	57.1	1.5
10	10–21–24	41	12	29.2	12.0
11	10–21–24	53	32	60.3	5.8
12	10–21–24	87	40	45.9	3.4
13	10–20–24	118	77	65.2	7.0
14	10–21–24	76	52	68.4	4.8
1	5–18–25	60	28	46.6	9.7
2	5–18–25	25	11	44.0	8.0
3	5–18–25	60	24	40.0	3.0
4	5–19–25	29	15	51.7	9.0
5	5–18–25	81	42	51.8	7.0
7	5–19–25	68	30	44.1	9.7
20	2– 3–25	105	30	28.5	Farm abandoned
21	2– 3–25	67	20	29.8	" "

	Data Regarding Initial Surveys in 1923, 1924 and 1925				Last Survey—1931
Farm	Date of Survey	No. of People Examined	No. Positive	Percentage Positive	Percentage Positive
24	2– 3–25	51	17	33.3	19.3
25	2– 3–25	22	6	27.2	17.0
37	2– 3–25	36	18	50.0	13.5
Q. Seca	5–18–25	35	11	31.4	7.6
B. Vista	6– 8–25	122	42	34.4	3.3
Las Flores . . .	7–12–25	52	17	32.6	3.1
N. Chino	6– 8–25	73	22	30.0	3.3
Los Indios . . .	6– 8–25	54	11	20.3	5.6
P. Blancos . . .	6– 8–25	66	17	25.7	5.3
Urraco	6– 9–25	40	9	22.5	2.0

A comparison of the percentage found positive at the time of the initial survey (fifth column), with the percentage positive at the time of the last survey in 1931 (sixth column), will give some idea of the progress made in our campaign against malaria.

We have found that the surveys and the treatment of the individuals found positive can be carried out on a large scale in conjunction with the daily routine work—systematic effort, efficient cooperation, and hard work being the essentials for success. A rapid worker can collect from 500 to 800 thick films in one day; and the only assistance necessary is to have someone record the names of the subjects as the bloods are taken and to give the films a corresponding serial number. Thick films should be used exclusively.

In routine examinations of thick films we endeavor to cover an average of approximately 75 fields before a slide is considered to be negative. It is estimated that one parasite to every 100,000 red cells is necessary to produce symptoms of malaria. A properly prepared thick film should show about 75 white cells per field. Consequently, in looking at 75 fields we have covered approximately one millimeter of blood or fifty times the amount necessary to reveal parasites at the ratio of 1 to 100,000 red cells.

If a camp or unit shows a positive rate of more than 10%, an effort is made to conduct another complete survey of it within eight to ten days after the termination of the routine treatment of those individuals whose blood was found positive in the preceding survey. This serves the double purpose of determining the results of treatment and of detecting any new cases which may have developed. The results of treatment have been uniformly successful—in only two instances have I found individuals remaining positive after they had presumably received the prescribed treatment,* and in those cases it was questionable whether or not they had actually taken the medicine supposedly administered to them by the Overseer.

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* After the examinations of all the blood specimens collected during a survey are completed, a list of the positives is sent to each camp with medicines sufficient for six days treatment of each infected individual. One plasmochin compound tablet and ten grains of quinine, twice a day, is administered personally by the overseer, foreman or other responsible person; and, after the period has expired, a report is sent to the Hospital signifying that to his personal knowledge all have received the full course of treatment or stating the reasons why any have failed to receive the prescribed medicine.

SUMMARY

The more salient features connected with our surveys and the methods of treatment may be briefly enumerated:

1. *During the year 1930, we made 41 surveys throughout the Division; while we made 142 surveys during 1931. Cases of malaria admitted to the Hospital in 1930, from areas covered by the surveys of that year, numbered 690; while the cases admitted in 1931, from the areas covered by the surveys of 1930, totaled only 345. The number of individuals residing in those areas were approximately the same during the two periods—1930 and 1931, respectively.*
2. *This work can be carried out, on a large scale, at nominal cost.*
3. *Sporadic outbursts, such as often occur in flooded areas, can be promptly controlled.*
4. *Hospitalization can be materially reduced.*
5. *Malaria control is essential to the health of communities in districts where the disease is endemic; and inevitably results in improving camp conditions, which is a factor in stabilizing working forces.*

ANOPHELES MOSQUITO CONTROL

CARLETON HALE
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How far can the anopheles mosquito fly? What results are obtained by destroying their breeding places near to the living quarters, when outside of this short radius of control there are more breeding places? These are the questions which are most frequently asked of a Sanitary Inspector in the various Divisions of the United Fruit Company.

The answer to the first query is: "Nobody really knows." Many experiments have been made to determine the flight of anopheline mosquitoes; and stained mosquitoes have been recovered more than a mile from the place where they were released.

It is difficult to give an answer to the second question. The dragon fly and its phantom larva consume both the larva and the adult mosquito. The top-feeding minnow is capable of eating vast numbers of larvae in a short period. The wonderful results obtained by the United Fruit Company in its short range mosquito control work tend to justify our belief that the natural enemies of the mosquito, such as dragon flies, bats, birds, and lizards, do not permit large numbers of mosquitoes to travel any great distance from their breeding places. The female anopheles, if she can get a blood meal nearby, is not inclined to fly very far from her breeding place; and it is often observed that mosquitoes will abound in a pasture where cattle are confined while, at the same time, they will be very scarce in a nearby camp or town. It is mathematically certain that, the larger the area subjected to mosquito-control work, the fewer will be the number of mosquitoes found in the center of said area. It must be taken for granted that the mosquitoes which are breeding nearest to living quarters will stand the best chance of attacking the occupants, while those with the longest distance to travel stand the least chance of surviving the perils which must be encountered during their extended flight. Ants from an ant-nest which is ten feet from a house have a better chance of entering that house, if they seek to do so, than do those from a nest which is one hundred feet distant. This reasoning can be applied to mosquitoes as well as to ants.

FACTORS IN MALARIA CONTROL WORK

Many and diverse factors enter into malaria control work. The best authorities seem to think that the males exceed the females in a hatch; and, as the female is the one to be feared, we are fortunate that she represents the smaller proportion of the hatch. The problem of malaria control in the properties of the United Fruit Company is a much more difficult one than it is in the temperate zone. In a temperate climate, by commencing work at the proper time, it is not very difficult to keep the mosquito-breeding level very low.

In the tropical climates of the properties of the United Fruit Company we have breeding for practically the entire year. Heavy, continual downpours will wash out the larvae in streams and certain drains; while, on the other hand, these same rains will cause depressions of all sorts to become saturated, and pools of water will remain longer than when we have only light showers. Under such conditions, some of our worst breeding areas are found in corrals and pastures around labor quarters. Drains which are not functioning properly, and railway borrow pits, are then prolific breeding grounds. In the dry season, rivers may become sluggish; and breeding will then occur in the vegetation along their edges, in little pockets in the bends of the river, between rocks or pebbles, and among floatage of all kinds. Lagoons and swamps become shallow, and fill with vegetation; and are good breeding areas for mosquitoes, as fish can no longer penetrate among the dense growths.

Where irrigation is utilized in banana cultivation during the dry season, we can expect breeding, unless the water in the canals flows very swiftly or the canals are cement-lined and kept free of vegetation; as mosquitoes will breed prolifically along the edges of a slow-flowing canal when the vegetation is dense. Drainage ditches and borrow pits along the sides of irrigation canals are always prolific breeding-places, due to the seepage water found in them. In the rainy season, when the irrigation water is turned off from the canals, they collect rain water in shallow pools; and then are generally worse sources of breeding than in the dry season. The ditches and borrow pits, which in the dry season held seepage water from the canal, now hold rain water.

CHANGEABLE CONDITIONS ENCOUNTERED

It can be seen, from the description given above, that malaria control is not a seasonal problem under such conditions; and yet it is a very interesting one. We figure on a certain month being rainy, as it has been in the past; but we may have a year in which it is very dry—and vice versa. Places that have always been ideal breeding grounds for anopheles will suddenly show no breeding; and then, again, a place where larvae have never been found will show breeding.

There are certain streams and other areas where breeding is seldom found; and this may be due, perhaps, to certain chemicals in the water or to a lack of food that the larvae require. The Local Sanitary Inspector gets to know these areas, and will remark: "I seldom find breeding here." However, no chances are taken; and all potential breeding areas are dusted or oiled.

There are other spots that are always certain to have breeding. Such places should receive more attention than those which show infrequent breeding. Sometimes an Inspector will report that he can see no reduction in the amount of breeding in a certain area—it will then be suggested to him that he go over the area twice as often as usual, until he gets it controlled; as perhaps too long a time has been elapsing between dustings. He should also see that his proportion of Paris green to diluent is right and properly mixed. There is always a cause for such conditions; and, when the remedy is found, breeding will be controlled.

Some places, where certain vegetation is found, rarely have breeding; and attempts have been made to transfer such vegetation to other places. However, this has not met with much success. It is probable that the principal reason for failure in such instances is that exactly the same conditions do not obtain as existed where the vegetation was taken from.

GENERAL MALARIA CONTROL MEASURES

In the anti-malarial work on the United Fruit Company's properties, we have to consider our work from the viewpoint of a business concern that must compare costs with results obtained. By reducing malaria, we increase labor efficiency and production; and consequently effect economy.

The labor forces of the United Fruit Company, who are well housed, regularly paid, and fairly stable, lend themselves to a definite campaign against the gametocyte carriers. It is impossible to prevent all anopheline breeding in the immense areas with which we have to deal; and to cure all carriers of gametocytes would be a stupendous task. To reduce the percentage of anopheline breeding, and not reduce the number of gametocyte carriers, does not give results; and it is equally futile to reduce the percentage of carriers of gametocytes and not reduce the anopheline breeding. It is therefore a mathematical proposition—we must reduce the breeding of anopheles as much as possible; and, at the same time, treat with plasmochin and quinine all individuals found positive for malarial parasites so as to reduce the percentage of gametocyte carriers in a given area. This is the practice followed in the various Divisions of the United Fruit Company; and it is producing good results.

Fish abound in most of the bodies of water around labor camps; and they represent one of the most economical methods for the prevention of breeding. Such bodies of water, when their edges are kept free from vegetation and from all kinds of floatage so as to permit the fish to feed right up to the banks, are comparatively free from breeding; but, unfortunately, we have innumerable large areas where the cost involved in keeping the edges clean would be excessive. Most of our control of anopheles breeding is accomplished by the use of Paris green.

USE OF PARIS GREEN

Until about a year ago, practically all dusting with Paris green mixtures was done by hand. There were several reasons why knapsack dusters were not used. One was the difficulty encountered in getting suitable dust in the various Divisions to be mixed with the Paris green, so that the dusters would operate in a satisfactory manner. Unless the dust was very fine, it clogged the screener in the type of duster which we were attempting to use.

USE OF DILUENTS OBTAINABLE LOCALLY

Various diluents were mixed with the Paris green which, at that period, was used in the ratio of one part of Paris green to ninety-nine parts of diluent. Some of the diluents used were: unslaked lime, road-dust, saw-dust, ashes, sand, and a silt-like dust obtained from certain salt marshes which had dried up after they had been free from exposure to high tides for a long time. Efforts were made to collect road dust in some of the Divisions; but this was not very successful—a long, dry spell was needed, and the dust had to be obtained from a road which was used extensively so that it would be thoroughly pulverized; and comparatively few such places existed in our Divisions. As I recall, the only place where we were assured of a plentiful supply of fine road-dust was in Jamaica, near a sugar-cane mill, where hundreds of carts, mules and oxen kept the roadway in clouds of dust. In one Division (Tela, Honduras), where a saw-mill was operated continually, there was an abundance of saw-dust which we were able to use exclusively there after it had been passed through an 18-mesh wire screen; and this was fortunate, as road-dust was unobtainable in that locality. In another Division (Guatemala) saw-dust was also used; but there we were not so fortunate in having a large supply readily accessible, and had to supplement our local supply by obtaining additional quantities from Guatemala City, where it was obtainable at a very low price and was transported by the International Railway without charge—furthermore, it was derived from cedar logs, and consequently was so fine that it required no screening. In Castilla (Honduras), we were able to operate with the small amount of saw-dust obtained from the shops of the Construction Department, supplemented by dust collected under houses and in corrals during the dry season. In the Banes Division (Cuba), silt collected from salt marshes, combined with equal parts of ashes and saw-dust, was used. In the Preston Division (Cuba), lime obtained from the Company's lime kiln was mixed with saw-dust and ashes; and silt from a dried up salt marsh was also used in the combination. In Colombia, a fine road dust was used; but it was not fine enough for the dusters. Costa Rica was using a fine sand obtained from the beach. All of the mixtures mentioned were fairly satisfactory. The men carried the material in small, canvas sacks.

DILUENTS USED AT PRESENT

It was ascertained finally that soapstone and limestone dusts, and slaked lime, could be obtained at prices that permitted their use in our various Divisions. Soapstone, limestone, slaked lime, and Paris green will all pass through a three hundred mesh wire screen. This uniform fineness of the ingredients insures a perfect blending of the Paris green and its diluent, and facilitates the use of blowers. (Such was not the case, when sand, saw-dust, and coarse road-dust were utilized and the dusting was done by hand. A grain of sand or a particle of saw-dust would have many particles or grains of Paris green clinging to them; and the grains or particles of the diluents, being much larger than the grains of Paris green, did not permit of a perfect blend and resulted in a considerable waste of Paris green.)

As an example of the saving effected by using mechanical dusters, I may mention the Costa Rica Division. When I first inspected conditions there, sand was being used as a diluent. During the year 1930, about 265,000 pounds of sand were used in the work; and 2,010 pounds of Paris green were needed to mix with the sand. It was a slow and costly operation to transport this sand throughout the Division to the various places where it was required. Many containers were used to carry it; and it necessitated considerable effort to get it placed where it was needed. To mix this large quantity took time; and the men could carry only a small amount on account of its weight. When it was distributed by hand, it covered only a small area compared to dust distributed from a duster. Mechanical dusters were introduced, and Paris green mixed with limestone and slaked lime was used in them; and, by using dusters, the same area can now be covered with one-tenth of the amount of Paris green (although we used 3% of Paris green, as compared with 1% when sand was used) and one-fortieth the amount of diluent required formerly. Now, instead of continually shipping materials out to the various farms and collecting empty containers, the small amount required in the dusters is carried in two or three small cans on the car of the sanitary gang and is used as required.

In the Chiriqui Land Company Division (Panama), the use of mechanical dusters has reduced the amount of Paris green to one-tenth of that consumed formerly; and the labor force has been reduced fifty per cent. With the dusters, 3% instead of 1% of Paris green is used; and in this Division slaked lime is used as a diluent, instead of limestone or soapstone, as there was a quantity on hand.

When the supply of lime is exhausted, we shall use limestone or soapstone; and this will enable us to determine the relative quantities used and the difference in cost of the two diluents.

In Castilla and Puerto Cortes (Honduras), and in Guatemala, soapstone dust is now used; and, in Tela, limestone dust is utilized.

Costs and Quantities of Paris Green Diluents Now Used

The average cost of slaked lime delivered in the different Divisions is two cents a pound. The prices on the limestone and soapstone average from one cent to one and three-quarters cents a pound—this difference is due mostly to the varying freight rates and customs duties. Slaked lime costs slightly more; and, as it is lighter than soapstone or limestone, is ejected faster from the dusters and therefore is consumed more rapidly. At the present time, I am unable to give comparative figures on the working cost of slaked lime and of limestone and soapstone.

All of our calculations for percentage mixtures are based on bulk and not on weight. A "3% mixture of Paris green" means three parts of Paris green to ninety-seven parts of dust. The mistake is often made of saying "three pounds of Paris green and ninety-seven pounds of diluent. This is plainly wrong, as not all diluents weigh the same as Paris green. For example, a measure holding three pounds of Paris green will hold only about one pound of lime.

Prior to 1931, our mixtures contained one part of Paris green and ninety-nine parts of the diluent. The higher the percentage of Paris green, the more rapidly will the mixture kill larvae. As a material reduction in our Paris green consumption had been effected by using dusters; it was decided to increase the Paris green percentage in the dust mixture, and to thereby increase its lethal power while still using relatively little Paris green as compared to the amount required when dusting was done by hand. One manufacturer of Paris green recommends ten per cent of Paris green and ninety per cent of the diluent; and, although such a mixture is expensive, it does increase the killing power of the mixture over a given period of time.

Several brands of Paris green have been used in the different Divisions of the United Fruit Company. The one which has given us the best results is of standardized, reliable manufacture; is guaranteed to contain fifty per cent of arsenic; and is dark green in color. Other brands are lighter in color; do not kill so quickly; and are not entirely satisfactory. Men who have had sufficient experience in the work of dusting, notice when a Paris green mixture is only partially effective and advise the Local Inspector accordingly. Anophelex, a special brand of Paris green, was tried; but our experiments with it gave no better results than were obtained with a standard brand of Paris green.

Precautions Exercised to Avoid Arsenical Poisoning

During the period when dusting was done by hand, one or more of the individuals who handled the material in each Division suffered at some time or other from arsenical dermatitis, which occurred most frequently on the hands and arms, back of the neck, and around the groins and scrotum. Some men were more susceptible to the effects of Paris green than others; and, as a rule, those who continued with the work for any length of time seemed to get used to it and became more or less immune. The use of mechanical dusters prevents this; although one regrettable instance of internal poisoning occurred in the Costa Rican Division during 1931, soon after the change was made from hand distribution of Paris green to the use of dusters. The only manner in which it seems possible for this accident to have happened is that, having become accustomed to the use of sand which is heavy and flew very little while it was being mixed, they did not take into consideration the extreme lightness of the soapstone and slaked lime mixture, and inhaled the light dust mixture while emptying the mixer. When at work in the field, the men are trained to walk to windward of the area that is being dusted. While all the men are advised to cover their noses and mouths when they are mixing Paris green; very few do so, as they become experienced in the work and avoid inhaling the dust.

USE OF MECHANICAL DUSTERS

Three types of mechanical dusters are being used at present in our work; all of which are activated by bellows.

The "American Beauty" is used in Colombia. The container of this duster is cylindrical, and the dust in the container is stirred by a fan-shaped force feeder. Its blower is moved by a system of gears. It works well; but is rather heavy and complicated, although I understand that there is a more recent model with fewer parts than the ones we are using.

In three other Divisions—Costa Rica, Tela and Castilla—we are experimenting with the "Chipman" duster. It is rather heavy (weighing 21 pounds when empty); but has a canvas support for the back, which is very convenient. The double-acting bellows give a continuous blast of dust. It has no screener, as have the two other types with which we have had experience. This prevents any clogging of the feed line.

Both the "Chipman" and the "American Beauty" dusters are heavy and rather bulky for our work, and occupy too much room on the small railroad motor cars used in our work in the different Divisions.

The other type of duster which we have used is manufactured in Italy; and in Guatemala, Puerto Cortes, Almirante and Chiriqui it is used exclusively. Some are in use also in Tela, Castilla, and Costa Rica, where we are experimenting with the "Chipman" duster. The Italian duster is light; and occupies only about half the space of the other types mentioned. It holds about as much dust as a man can conveniently carry; is much cheaper than the others; and is easier to repair, although the question of repairs is a minor matter as there are well-equipped mechanical departments in the various Divisions where they can make any repairs required.

SANITARY PERSONNEL

It is very difficult to obtain good men for malaria-control work; and this statement applies to Local Sanitary Inspectors as well as to the actual laborers. They must be well trained and interested in the work, or they will never become proficient. It is a special kind of work; and those who become interested in it and remain with the sanitary force seem to take a pride in their work, even though the work is hard and somewhat monotonous. In many of the Divisions, the men pass much of their time away from their home base at night; they are often wet all day and have no dry clothes for the night; they have no regular place to sleep, and do not get as good and nourishing food as they would get at home; and occasionally they are caught by heavy rains, miles from home, and if anything happens to their motor cars they may be compelled to spend all night in the woods out on the railroad line. To stand this type of work, the men must be physically fit and like the work; and they must realize that it is a task which must be accomplished at all costs. The average layman does not realize that mosquito-control work requires constant and conscientious work, and that a poor class of laborer cannot be used in this work. Unless the laborer is reliable and dependable, dangerous breeding places will be overlooked and disregarded; and malaria control work must be done in a whole-hearted manner, or the results will be unsatisfactory or entirely useless.

WHITEWASHING LABORERS' QUARTERS

In some of our Divisions, it is the practice to whitewash the inside of the laborers' quarters. Mosquitoes prefer to rest in dark corners, under beds, and upon clothes which are hanging on the walls. With whitewashed walls, there is less probability of mosquitoes resting upon them than if the walls are dirty and dark. For the best results, walls should be whitewashed twice a year. By using a spray pump to apply the whitewash, the work can be done very cheaply. One coat to a standard-sized room in a labor barracks should not cost over seventy-five cents. One of the best formulae for whitewash is that used by the United States Government on forts and lighthouses, and is made as follows:

> Half a bushel of unslaked lime, slaked in warm water and covered during the process to keep the steam from escaping.
>
> Strain the liquid through a fine sieve or strainer.
>
> Add a peck of salt which has been well dissolved previously in warm water; three pounds of ground rice, boiled to thin paste and stirred into the mixture while boiling hot; half a pound of powdered Spanish whiting; and a pound of glue which has been previously dissolved over a slow fire.
>
> Add five gallons of hot water to the mixture.
>
> Stir well; and let it stand for a few days, protected by a cover to keep it free from dirt.

The mixture should be strained carefully before it is used; and applied with a Deming spray pump. It should be sprayed on while hot. A poor job of whitewashing is a waste of money; but a coat applied in a proper manner is very serviceable.

CLEANLINESS AROUND HABITATIONS

Care should be exercised to prevent old cans, pans, bottles, and other classes of old and discarded receptacles that will hold water, from accumulating in the vicinity of living quarters. Unnecessary vegetation near dwellings should be cut down, to prevent mosquitoes from using the shade as resting places during the day. Attention which may be given to keeping quarters and grounds clean in the camps of laborers will produce gratifying results, as the laborers will be more contented and healthier.

SPRAYING QUARTERS

In two of the Company's Divisions (Tela and Castilla) systematic killing of mosquitoes in laborers' quarters was carried out for two years. This was done with hand sprays; and various insecticides were used. The same men who did the dusting and oiling were employed in this work; and the work was done in an excellent manner. It was rather slow work, if it were handled properly; as the men sprayed the corners of the rooms, and looked into all mosquito nets and killed the mosquitoes found in them. As many as fifty anopheles have been found and killed in a net occupied by someone the previous night. There is no doubt but that this procedure lowers the mosquito index in camps; and many infected anopheles are destroyed in this manner. The men became adept at discovering the mosquitoes on the walls and elsewhere, even though this was difficult in many rooms where the walls were dark and smoky. Only conscientious, polite and diplomatic men could be used in this work. They must be conscientious, as it is impossible for the Inspector to be present in every room in order to see that the work is done properly; and they must be polite and diplomatic, as many people at first resented having their rooms inspected and sprayed, and time and patience were required before the occupants could see the advantages which they derived from such work. That it was possible to carry on work of this character in those Divisions for such an extended period and with so little trouble, speaks well for the personality and capabilities of the Local Inspectors and the men working under them. In the Tela Division it was discontinued as the result of reductions in the sanitary personnel; and in Castilla it was considered advisable to have the limited number of employees assigned to sanitation devote a greater portion of their time to the destruction of breeding areas. To spray a room effectively, it should be closed tightly and left closed for a few minutes after the spraying is finished; but in our Divisions this procedure would involve too much time and be too expensive, and would also arouse more strenuous objections on the part of the occupants. Furthermore, even this method will not give perfect results unless the rooms are ceiled.

PRACTICAL MEASURES FOR MALARIA CONTROL

Under favorable conditions, the destruction of mosquitoes in the rooms is a helpful measure in malaria control work. If the rooms are ceiled and have screened doors and windows, and if the tenants are taught to use a spray to kill any mosquitoes which may be found inside, very few cases of malaria should develop; but, with the open type of barracks, I do not believe that the results obtained by such measures justify the expenditures. It is better policy to direct our efforts to the elimination of accumulations of water around living quarters. Where this is not practicable, on account of the expense involved, weekly applications of Paris green or oil should be made to all temporary or permanent sheets of water within a five-hundred foot radius of dwellings. The most dangerous anopheles breeding-places with which we have to contend in all Divisions are shallow deposits of water in corrals, yards, canals, drains, borrow pits and other shallow depressions containing water which is sufficiently warmed by the sun's rays.

To the average person a mosquito is a mosquito, irrespective of whether it is a malaria carrier or not. The Local Sanitary Inspector may hear considerable adverse criticism of his work when a town or camp is infested with culex mosquitoes, even though his efforts to destroy the anopheles mosquitoes in that locality may be very good and the breeding of anopheles in that area may be almost nil. In such instances, it may be advisable to use oil to destroy all kinds of mosquitoes in order to keep the people contented; but, as one pound of Paris green costing about twenty-five cents will accomplish as good results in killing anopheles as five dollars worth of oil, it cannot be considered economical or very good policy to use oil except in certain cases and under special conditions. The drainage done to improve banana lands has been of great assistance in reducing anopheline breeding areas near labor camps. By means of so-called "dragline" canals, much land covered formerly with sun-warmed waters and suitable for the breeding of anopheles mosquitoes has been dried up. Where the cost is not excessive, the permanent filling, draining, or leveling of mosquito-breeding areas is the best means of eradicating malaria.

Whenever possible, an educational program is of great benefit—especially if it reaches the children as well as the adults. It was formerly very difficult to get the laboring element to take quinine; while it is now exceptional to find anyone with fever who will refuse to take it. This change of attitude has resulted from conscientious and persistent efforts on the part of the dispensers and the personnel in charge of labor units; and, through their insistence that the medicine must be taken and their explanations as to the reasons for taking it, the laborers and their families have at last recognized the advantages to be derived from the administration of quinine and plasmochin and from sanitation.

CONGENITAL MALARIA—A CASE REPORT

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A 19-year-old Colombian woman, of the Spanish-Indian type, was admitted to the hospital with fever on the afternoon of June 19, 1931. She said that she had suffered frequently from similar fever attacks. This time she had been ill with fever, chills, headache, and vomiting for the past 11 days. She had taken no quinine. Being pregnant for the first time, she became alarmed when she noticed that in the mornings she was having recurring backaches, and pains in the lower abdomen. The fetal movements, which had been stronger than usual on the morning of admission, had subsided in the afternoon after the train ride to the hospital.

The physical examination showed her to be a well built and fairly well nourished young woman. The temperature was 105°F. A general enlargement of the lymph glands and edema of the legs were noticed. While the lungs and heart were normal, the liver and spleen could be palpated about three fingers below the costal margins. The fundus of the uterus stood midway between the umbilicus and the costal margin. Labor pains occurred about every five minutes. The fetal heart sounds could be heard feebly between the symphysis and the umbilicus. Their rate was 160 per minute. A clinical diagnosis of malaria and threatened premature partus was made.

Rupture of the membranes occurred about an hour after admission. The patient received intramuscularly two injections of quinine $7\frac{1}{2}$ grains each, during the night; and, 10 hours after admission, I delivered her of a male child in breech presentation. The child was small (1.5 lbs.) and asphyctic; but breathing set in after 5 minutes resuscitation. While I cut and tied the cord, I secured a drop of blood from it. The placenta was delivered 25 minutes later, with the help of a gentle Credé. It was complete, and was macroscopically normal except for an unusually deep brown color of its maternal surface. After removing the blood clots, some crushed material of the placenta was obtained for microscopical examination. Three hours after delivery, a drop of blood was taken from the child's ear lobe.

The laboratory examination revealed numerous rings and gametes of estivo-autumnal malaria in the peripheral blood of the mother, sporulating forms of estivo-autumnal in the placenta, and estivo-autumnal rings in the blood from the umbilical vein (1 or 2 in each field of vision); and also a few small ring forms in the child's peripheral blood. Daily examinations of the child's blood showed constantly a few small estivo-autumnal rings until the eighth day, when the blood became negative. There was some fever on the third and the fourth days.

While the spleen could not be palpated, the liver was felt about one finger below the costal margin. The child died on the tenth day, after his blood had been free from parasites for two days.

Post mortem findings:—In a partial autopsy, which could not be obtained until ten hours after death, we removed pieces from the liver, from the slate-colored and slightly enlarged spleen, and from a rib. Crushed material from these was examined immediately; and malarial pigment was encountered in the spleen and the liver, as well as a few ring forms of parasites in the latter. Dr. H. C. Clark, Panama, who examined sections from these organs, reported the finding of clumped (malaria) pigment in them.

COMMENTS

We have reported this case on account of the very small number of definitely proved cases of congenital malaria recorded in the English and American literature. Though H. C. Clark (Jour. Exper. Med. 4:427, 1915) found, among 400 placentas, 4.7% infected with malaria; he observed malarial parasites in the umbilical cord only once. As there had been an accident to the placenta in that case; he concluded that, without such a lesion, no transmission of the parasites could have taken place. That the malaria process alone will not produce such lesions, which might permit a passage of parasites from the maternal into the fetal circulation, seems to be proved further by the recent findings of Wislocki (Bulletin Johns Hopkins Hosp., Sept., 1930, Vol. 47, No. 3). The blood from the maternal side of the placenta contained many pre-segmenting and segmenting forms. The histological examination, however, revealed that the villi (including their stroma and covering chorion syncytium) were anatomically normal, and were not visibly affected by the malarial organisms or their products. In spite of the fine distribution of the malarial pigment found on the maternal side, no traces of such pigment or of parasites could be found in the chorion syncytium or the fetal placental tissues lying below it.

Though no gross lesions of the placenta were observed in our case, we believe it to support Dr. Clark's opinion. The woman was suffering from a severe syphilitic infection; and the color aspect of the placenta was entirely different from the one we have observed in about fifty women who suffered from malaria during or shortly before delivery. In spite of the microscopical routine examinations of the blood from the placenta and the umbilical cord which we did in those cases, and the high incidence of placental malaria infections they revealed (See Annual Report for 1928); this is the first time that we have encountered malarial parasites in the cord and the peripheral blood of a newborn and, to our knowledge, the second case of congenital malaria to be reported in the American literature.

MALARIAL ORCHITIS—CASE REPORT

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Malarial orchitis is rarely seen, and the literature on this complication is very scant; but a few cases have been recorded by different authors.* The case I am reporting is undoubtedly a typical case of orchitis secondary to malaria.

CASE REPORT

A Cuban male, 19 years of age, first visited the Clinic on May 10th, 1930.

History.—The patient complained of swelling and pain of the left testicle, which had commenced simultaneously with an attack of fever two days before he sought medical attention. *He stated that he had not suffered from any traumatism nor ever had any venereal infection.*

Physical Examination.—The heart, lungs, and abdomen were negative; temperature was normal; tenderness and inflammation of left testicle; epididymis not affected. Blood examination for malaria, which is a routine procedure, was negative.

Treatment and result.—On the first visit (May 10th) he was instructed to rest, and to apply cold packs to the testicle without any other medication. He reported again on May 15th; and stated that he had had some relief from the cold packs at first, but that since the previous night the pain had become more acute and was accompanied by another attack of fever and chills. At this time, his temperature was 103°F.; and the blood examination showed E.A. malaria parasites—both ring forms and crescents. One gram of quinine was administered intramuscularly; and the patient was ordered to go home and rest, and to follow our routine malaria treatment which consists of 1 tablet of Plasmochin Compound (each tablet containing 0.01 gram of Plasmochin and 0.125 gram of quinine sulphate) daily until four are taken, and 10 grains of quinine twice a day for an extended period.

He reported again on May 22nd, stating that he had had no more fever and that the swelling and pain had disappeared entirely within 48 hours after the quinine injection was given. Blood examination was still positive for E. A. malaria—crescents. He was instructed to take 3 Pink Tonic Pills daily and 1 quinine tablet (5 grs.) nightly for two weeks.

On June 7th, he called again at the Clinic; and stated that he was feeling completely well.

Resume of results of blood examinations.—May 10th, negative for malaria parasites; *May 15th*, positive for both ring forms and crescents; *May 22nd*, positive for crescents; *June 7th*, negative.

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* Castellani and Chalmers mention its occurrence in their Manual of Tropical Medicine.

SUMMARY

A differential diagnosis must be made between malarial orchitis and acute orchitis of other origin, in malarial subjects. Syphilitic and tubercular orchitis need not be considered, as the progress in these cases is more insidious and signs of acute inflammations are absent. In orchitis due to trauma or venereal infections, the history and physical signs should make the diagnosis clear.

SECTION III

IODOXYQUINOLIN SULPHONIC ACID (ANAYODIN) IN THE TREATMENT OF INTESTINAL AMOEBIASIS

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Many surveys and special studies have demonstrated the world-wide distribution of the Endamoeba histolytica and especially its prevalence in tropical and subtropical countries where the conditions of sanitation favor its survival and spread. The incidence of infection is variously estimated from four per cent. in parts of the temperate zone, to as high as sixty per cent. in certain tropical areas. Concepts of its relations to man have changed. It is generally recognized now that the clinical expression of amoebiasis is not limited to acute and chronic dysentery and to abscess of the liver, but that these are the least common of its effects upon the host. James[1] has attributed to it a large proportion of obscure gastro-intestinal conditions in which neither diarrhoea nor dysentery appear as cardinal symptoms. A very varied picture may occur in which alternating constipation and diarrhoea, anorexia, flatulence, chronic indigestion, and abdominal pain may be prominent. In many instances the infection remains latent for considerable periods of time only to develop an acute phase after intercurrent disease or some dietary indiscretion, and not infrequently abscess of the liver or acute hepatitis develops in an individual who has never experienced an acute attack of dysentery.

In general two opposed views of the host parasite relationship are held by competent authorities. One school maintains that the Endamoeba histolytica is invariably a tissue parasite and that the organisms encountered in the stool even in the absence of acute symptoms are thrown into the lumen of the bowel by the rupture of miliary abscesses, or in the discharge from an amoebic ulcer. Clinical experience has led some observers to doubt whether the so-called healthy carrier is always free from symptoms,[2] and Craig[3] considers the chronic cyst passer rarely if ever to be free from evidence of disease. Wenyon and O'Connor[4] say, "It is safe to assume that the Entamoeba histolytica in the intestine of the carrier is not comparable with the perfectly harmless Entamoeba coli, but that it is the cause of a certain amount of ulceration, and we know that this ulceration may be quite extensive without giving rise to any dysenteric symptoms." James[5] and others, however, believe that the amoeba may live free in the lumen of the upper colon as a symbiont and only invade the tissues and become parasitic under special conditions such as irritation of the mucus membrane or a lowering of the resistance of the host. It has been proven abundantly that the cyst passer is a dangerous potential source of dissemination. The menace to the individual himself and to those in immediate contact with him have led to the conviction that the carrier, whether suffering from the effects of tissue invasion or in apparent good health, should invariably be treated and, if possible, freed from his infection.

The recognition of the prevalence of amoebiasis and its clinical and sanitary importance have concentrated attention upon methods of treatment. The large number of preparations suggested and used for this purpose are indications of the relative inefficiency of the majority. Reed and his co-workers[6] have stated that no single one or combination of drugs meet the requirements of a completely satisfactory therapeutic agent. This they have defined as a preparation which is non-toxic, highly effective without adjuvants, suitable for oral administration, and of such a nature that it shall not interfere with the usual activities of the patient. Whether such an agent may be developed is a matter for speculation at present. The more detailed knowledge of the pathology of amoebiasis, moreover, points to certain other essential characteristics of such an ideal medication. It must be absorbed from the gastro-intestinal tract to be effective in the tissues of the colon and liver, yet a sufficient amount must remain in the bowel contents to destroy amoebae lying free in the lumen and upon the surface of the mucus membrane.

Of the many drugs which have been suggested and more or less favorably reported upon within recent years, none have been free from the criticism of insufficient amoebicidal powers or of too great toxicity for the host. Emetine seems to be an effective agent for the organisms that have actually invaded the tissues. While it frequently fails to eradicate infection and to prevent relapses, it produces a prompt improvement in the acute phases of amoebiasis. Its use is not free from danger, however, and numerous cases of severe and fatal poisoning have been reported. Moreover, it is a drug which cannot be used safely for an ambulatory patient. The best-known compound of emetine, emetine bismuth iodide is difficult and unpleasant for the patient to take and may cause intense emesis. Its toxicity is relatively high and Dobell[7] has shown that in monkeys the effective dosage is followed by toxic symptoms in eighty per cent. of the animals treated. The most widely heralded of the organic arsenicals, stovarsol or acetarsone, seems even less desirable since its amoebicidal power is low and it is not free from the stigma of poisoning.

The derivatives of oxy-quinolin are non-toxic but their efficiency as therapeutic agents in amoebiasis is still *sub judice*. The best known of the latter series, yatren, was introduced in 1912 as an antiseptic suitable for surgical purposes and especially as a substitute for iodoform. It has been marketed under a variety of different names such as tyren, griserinneu, loretin, xantropin, and xantren. Chemically it is said to be iodine 5 parts, oxyquinolin 8 parts and sodium sulphonate 7 parts, containing 28% iodine. Sodium bicarbonate, 20%, is added to increase its solubility. Muhlens[8,9] who first used this remedy in amoebiasis achieved spectacular results in chronic cases which had been resistant to other forms of treatment. The direct amoebicidal activity of yatren *in vitro* is low[10] and its mode of action is not entirely understood. Kessler[11] has shown by urine examination that iodine is split off in the body. Oral administration not infrequently is accompanied by diarrhoea with the passage of three to six soft or semi-solid stools of light yellow color. In some instances this may be severe but usually it is easily controlled by temporarily discontinuing the medication. The immediate effect of yatren is commonly a rapid improvement in the general condition of the patient and in the character of the stools. The amoebae with rare exceptions disappear not later than the third day, and other protozoa are reduced in numbers but not controlled so strikingly.[12]

Evidence regarding the final results is conflicting and difficult to evaluate. There are no standardized criteria of cure. The technique of stool examination, the number of observations and the interval after treatment all have varied and with them the reported results. Muhlens, using laxatives and the sigmoidoscope in his observations subsequent to treatment, found thirty per cent. of relapses, most of them unaccompanied by clinical symptoms. He states that the percentage of cures reported by others varied from sixty-six to ninety-two.

Unsatisfactory clinical results and apparent variation in quality of the imported preparation have led to its manufacture in the United States. The Council of Pharmacy and Chemistry of the American Medical Association has adopted the name Chiniofon for a mixture of 7-iodo 8-hydroxquinolin 5-sulphonic acid, four parts and one part of sodium bicarbonate, containing not less than 28.5% of combined iodine. Jones and Turner[13] have reported three years' clinical experience with this preparation. It was given by mouth in phenylsalicylate coated pills without dietary restriction and without confining the patients to bed. In children, the dosage was made proportionate to age. There was no evidence of toxic effect and while diarrhoea occurred in two instances it was not severe. In all, sixty-four patients were treated. Thirty-five, or ninety per cent. of the cases which could be followed, remained free from symptoms for from one to three years after treatment. Four, or ten per cent., suffered a relapse but a subsequent course appeared to be effective. Stool examinations were made on ten individuals subsequent to the period of therapy and nine of these were found to be negative for the Endamoeba histolytica. Reed and his co-workers,[6] however, state that Chiniofon has not been as successful as it was hoped would prove to be the case, and they believe that more satisfactory amoebicides are still to be developed in the oxy-quinolin series.

A similar preparation is available under the trade name of Anayodin. It is said by the manufacturer, Ernst Bischoff, to be iodoxyquinolin sulphonic acid with the addition of 22% sodium bicarbonate, and to contain 28% of iodine. This is firmly fixed so that no trace of free iodine is present. The pills are enteric coated, of four grains each, containing $3\frac{2}{10}$ grains of iodoxyquinolin sulphonic acid, $\frac{8}{10}$ of a grain of sodium bicarbonate, and approximately $\frac{9}{10}$ of a grain of iodine.

O'Connor and Hulse[14] have treated fifty-one cases who were followed clinically and by stool examination for periods varying from six months to two years. Four pills of Anayodin were given three times daily for eight days. No toxic symptoms were encountered and two patients who developed diarrhoea on ambulatory treatment were promptly controlled by bed rest. Six of the cases were acute amoebic dysentery, and the remainder either chronic or cyst passers who for the most part complained of weight loss, varied gastro-intestinal symptoms, or alternating constipation and diarrhoea. Forty-nine were relieved of their symptoms and during the subsequent period of observation neither free forms nor cysts were found in the stools. One case which relapsed was effectively checked by a second course of treatment. For amoebic liver abscess, however, it did not appear to be efficient. They conclude that this drug is an effective method of treating intestinal amoebiasis and that it exerts a direct action on the parasites in the intestinal tract only. In a clinical study without later stool examinations Thonnard-Neumann and Valera[15] compared this preparation and Yatren 105, which is Yatren with the addition of opium.[16] Anayodin was given in doses of four pills three times a day until negative stools were obtained but never for less than three days, while the dosage of Yatren was kept under 16 grains. The average duration of treatment before obtaining a negative stool was two and a half days for Anayodin, and three and a quarter days for Yatren. Both preparations are said to have caused frequent soft or liquid stools of greenish color, in some instances accompanied by colic.

Through the courtesy of Dr. Deeks and Dr. Connor the following studies on the treatment of amoebiasis with Anayodin were made possible. These observations were carried out at the Quirigua Hospital during the summer of 1931. The scope of this report is limited to the immediate effect of the drug upon acute dysentery and the relatively asymptomatic cyst passers. All stool examinations were performed by the writer. The specimens were studied within a few hours after evacuation and, when free forms of Endamoeba histolytica were suspected, the findings were checked by the immediate examination of a freshly passed stool. Only the simplest methods were used. In each instance two seven-eighths inch cover-glass preparations were made. For one the stool was emulsified in normal saline solution and for the other in double-strength Grams iodine.

The clinical material was obtained by the examination of a considerable number of individuals. These fall into three groups. A series of three hundred admissions to the Hospital composed largely of laborers and their families but including a few patients in the First Class service as well; secondly a group of one hundred and twenty-seven employees living in barracks immediately adjacent to the hospital; and thirdly one hundred and twelve individuals resident in Quirigua Village, who for the most part were not Company employees. No attempt was made to determine accurately the exact incidence of intestinal protozoal infections; the purpose of the work being to obtain as large a number of heavily infected individuals as possible.

TABLE 1

Family Incidence—Intestinal Protozoal Infections

No.	Family	No. Ex.	No. in Family	E.H.	Coli	Nana	Butschlii	Giardia	Chilomastix	Trichomonas
1	R.L.	2	2	1	1	—	1	—	—	—
2	A.	2	3	1	1	2	1	—	—	—
3	M.	7	7	2	3	1	1	1	—	—
4	A.	6	6	2	3	2	3	—	1	—
5	P.	4	4	1	1	2	1	—	—	—
6	J.	7	7	1	4	1	2	—	—	—
7	B.	4	7	1	1	—	1	—	—	—
8	G.	3	4	1	1	—	—	—	—	—
9	M.	2	3	1	1	—	1	—	1	—
10	C.	2	2	1	1	1	1	—	—	—
11	S.	6	7	3	—	—	—	—	—	—
12	S.	11	11	3	7	5	2	2	3	1
13	R.	5	6	2	2	1	—	1	1	—
14	F.	5	5	1	4	1	2	—	—	1
15	E.	3	3	2	1	1	—	—	—	—
16	M.	2	2	—	—	—	—	1	—	—
17	M.	3	4	—	2	—	—	1	—	—
18	M.	7	8	—	1	1	2	1	1	—
19	D.	14	16	—	4	—	1	—	1	—
20	A.	9	9	—	1	2	1	7	1	—
21	B.	6	6	—	1	—	—	—	1	—
22	S.C.	7	7	—	—	—	2	3	—	—
23	S.	5	5	1	1	—	—	1	—	—
24	R.	3	3	1	—	—	—	—	—	—
Total......		125		25	41	20	22	18	10	2
No. of infected families				17	20	12	15	9	8	2
No. of families with multiple infections				6	8	5	6	3	1	—

Errors of diagnosis were guarded against by adhering rigidly to well established criteria of identification. No cyst was considered to be Endamoeba histolytica unless it presented the following characteristics: in the saline suspension, invisibility of the nuclei and the presence of chromatoid bodies with definitely rounded ends; in the iodine suspension absence or practical invisibility of the chromatoids, and four nuclei paired at opposite poles each with a fine central karyosome. No free amoeba was accepted unless it showed endoplasm containing red blood cells, clear glassy ectoplasm with blade-like pseudopodia, and progressive motion across the microscopic field. While certain cases were discarded which might have proven to be histolytica if stained by the Haidenhain method, it is improbable that many have been included which do not properly belong in the series.

In the course of these investigations the family groups of infected individuals were examined whenever possible. For the most part, however, only one stool was obtained from each individual although the effort was made to secure at least two. Among the one hundred and twenty-five people living in intimate contact with cyst passers, twenty per cent. were found to be positive in contrast to 7.6% among the 539 similarly examined during the summer. Of the twenty-four family groups studied, six were found to have two or more infected individuals. (Table 1) The family incidence rate for Endamoeba coli, Endolimax nana, Iodamoeba butschlii and Giardia lamblia was quite similar.

TABLE 2

Anayodin Treatment of Acute Dysentery

No.	Name	Daily Dose	Days of Rx	Stool Findings—Day of Rx								F.U.		Interval—End of Rx to F.U.	Remarks
				1	2	3	4	5	6	7	8				
1	R.	12	8*	+	–	–			?	–	–	–	–	6 weeks	
2	P.	12	8	+	+	?	–								Left hosp. on 5th day. Symptomatically well 6 wks. later.
3	H.R.	6	8	+	?	–	–	–	–	–	–				No follow up obtainable.
4	H.	3	6	+	?	–	–	–	–						“ “ “ “
5	C.	12	3	+	–										Left hospital.
6	A.	4	8	+	?	?				–		–		2 months	
7	S.	6	8	+	–	–	–	–	–	–	–	–	–	1 month	A chronic case.
Total Stool Exams. . .				7	7	6	4	3	4	4	3	3	2		
“ + “ . .				7	1	0	0	0	0	0	0	0	0		
“ ? “ . .				0	3	2	0	0	1	0	0	0	0		
“ – “ . .				0	3	4	4	3	3	4	3	3	2		

+ = Amoeba present. ? = Unidentifiable "degenerate cells." – = Amoeba absent. * = Anayodin discontinued for 3 days p 3rd day because of vomiting. F.U. = Follow-up.

Six cases of acute and one of chronic amoebic dysentery were treated with Anayodin alone. (Table 2) Four pills were given three times daily to adults and for children the dosage was proportioned according to Young's rule. In one instance, case #1, the diarrhoea was increased and accompanied by vomiting. All medication was discontinued for three days and then resumed without further evidence of intolerance.

Unfortunately it was impossible to obtain fresh stools from each patient daily through the treatment period. In no instance, however, were the amoebae demonstrable after the second day and in only one case were they present at this time. Three individuals who showed large non-motile unidentifiable cells are listed as questionable. Similar structures were found twice on the third day of treatment and once on the sixth, the latter from the patient whose treatment had been interrupted. While they were receiving Anayodin the stools were frequently greenish or yellowish in color. The amount of blood and mucus, however, rapidly diminished and there was a prompt objective and subjective im-

TABLE 3

Anayodin Treatment of Amoebic Carriers

No.	Name	Daily Dose	Days of Rx	Stool Findings—Day of Rx								F.U.	F.U.	Interval—End of Rx to last F.U.
				1	2	3	4	5	6	7	8			
1	F.P.	12	8			—		—				—	—	1 month
2	A.	12	8			—		—	—			—	—	1 month
3	F.	12	8	+	—	—	—	—				—	—	5 weeks
4	M.	12	8			—		—	—			—	—	1 month
5	A.	4 12	4 8					?				—	—	5 weeks
6	P.	12	8					—	—			—	—	1 month
7	R.	12	8		+		—					—	—	5 weeks
8	J.	4	8			—	—	—				—	—	10 days
9	B.	9	8			—	—		—			—	—	5 weeks
10	G.	12	8			?	—	—	—			—		10 days
11	A.	12 8	6 1			—		—	—			—	—	5 weeks
12	D.	12	8			—	—	—	—			—	—	5 weeks
13	G.R.	25T.	6									—		10 days
14	M.	9	8			—	—							
15	P.S.	40T.	5						—			—	—	5 weeks
16	I.N.	6	8			—	—		—	—	—	—		1 week
17	A.	9	7		—	—	—	—	—	—				
18	J.N.	6	8	+	+		—	—	—		—			
19	L.	9	8		—	—	—	—	—	—	—			
20	R.	Av. 9	7	+	—	—	—	—	—	—				
21	S.	9	8		—	—	—	—	—	—	—			
22	L.	9	7	+	?	—	—	—	—					
23	O.	9	4		—		—							
Total Stool Exams . .				4	9	16	15	16	15	5	4	15	12	
" + " . .				4	2	0	0	0	0	0	0	0	0	
" ? " . .				0	1	1	0	1	0	0	0	0	0	
" — " . .				0	6	15	15	15	15	5	4	15	12	

+ = E.H. cysts. ? = Unrecognizable cysts. — = E.H. cysts absent. F.U. = Follow up. T. = Total dose.

provement. Three of the cases had negative stool examinations one month, six weeks, and two months respectively after treatment. One who could not be re-examined reported by letter that she was symptomatically well, and three could not be traced.

The second series comprised twenty-three cyst passers. (Table 3) No attempt was made to restrict their activities or to alter their usual dietary. The dosage and administration of Anayodin were the same. No instances of intolerance were found in this group although it included several children.

In all instances the stools were heavily infected before treatment. Four who were examined after one day were found still to have typical cysts in the stools. Nine were examined after two days. Six of these were negative, two were positive and in one cysts were present which could not be identified surely. After the third day no infected stools were found. Fifteen of the twenty-three cases were re-examined from one to five weeks after treatment was completed. All of these were negative on one examination and twelve from whom a second stool was obtained failed to show free forms or cysts at either. The remaining cases had just completed the course of Anayodin when the work had to be terminated.

The effect of the drug on the other intestinal protozoa was less marked. (Table 4) Endamoeba coli present in sixteen cases before treatment was found in six after treatment. Endolimax nana was present in ten prior to therapy and in three during the follow-up observations. Iodamoeba butschlii was present in twelve before and in two after treatment. Giardia lamblia, Chilomastix mesnili, and Trichomonas hominis seemed to be little if any affected.

The results presented in this report cannot be accepted as final or conclusive but rather as a series of clinical observations of such a nature as to warrant more detailed and more strictly controlled study. The number of examinations after treatment was insufficient to disclose persisting light infections especially since the cysts are notoriously irregular in their appearance. However, the fact that these later examinations were uniformly negative would seem to indicate that some, at least, have been cleared of their infections especially since many of the cases were constantly passing cysts in large numbers before receiving Anayodin. The drug, therefore, appears to be an efficient remedy for the Endamoeba histolytica and the one which may be given without fear of toxic phenomena in either adults or children. Its exact value, however, cannot be estimated from the present studies. For the other intestinal protozoa its value is decidedly less.

The results obtained in the treatment of both the acute and the carrier cases of intestinal amoebic disease and the reports of others who have used the same or similar preparations indicate that the oxy-quinolin sulphonic acid preparations are among the most useful adjuvants to the treatment of amoebiasis. These drugs, however, fail entirely to meet the specifications laid down by Reed as those of the ideal medication for this infection. The distribution of the amoebae not only in the lumen of the colon but in the deeper tissues of its walls and not infrequently in the liver leads one to believe that the ideal will be difficult to achieve. At the present time it appears that the major effect of the Yatren series is exerted upon the organisms which are not deeply placed and that Anayodin or its chemical relatives may be depended upon to eliminate those in the lumen, and probably those situated on the surface of the mucosa and in open ulcers of the wall. The distribution and the nature of the changes frequently produced are such as to explain satisfactorily the recurrences reported after treatment. For the deeper lesions which are not accessible to a drug which is little absorbed, other methods must be utilized. Emetine, however, appears to act most effectively upon the amoebae situated in the tissues and to be less successful in eliminating infections which may be confined to the surface of the mucus membrane or the bowel contents. The evaluation of any therapeutic

TABLE 4

Anayodin Effect on Protozoa other than E. Histolytica

No.	Name	Daily Dose	Days of Rx	E. Coli		E. Nana		I. Butschlii		Giardia		Chilomastix		Trichomonas		Follow-up Exams.
				A.	P.	A.	P.	A.	P.	A.	P.	A.	P.	A.	P.	
1	F.L.	12	8	+	−	−	−	+	−	−	−	−	−	−	−	2
2	A.	12	8	+	−	+	−	+	−	+	−	−	−	+	−	2
3	F.	12	8	+	−	+	−	+	−	−	−	−	−	−	+	2
4	M.	12	8	+	−	−	−	−	−	−	−	−	−	−	−	2
5	A.	4 12	4 4	−	+	+	−	+	−	−	−	−	−	−	−	2
6	P.	12	8	−	−	+	−	−	−	−	−	−	−	−	−	2
7	R.	12	8	+	−	−	−	−	−	−	−	−	−	−	−	1
8	J.	4	8	+	−	+	−	+	−	−	−	−	−	−	−	2
9	B.	9	8	+	−	−	+	+	−	−	−	−	−	−	+	2
10	G.	12	8	+	−	−	−	−	−	−	−	−	−	−	−	1
11	A.	12 8	6 1	+	+	−	−	+	−	−	+	−	+	+	−	2
12	D.C.	12	8	+	+	+	−	+	+	−	−	+	−	+	−	2
13	P.S.	40T.	5	+	+	+	−	+	−	−	−	+	−	−	+	2
14	I.N.	6	8	−	−	−	+	−	−	−	−	−	−	−	−	1
15	A.	9	7	+	−	−	−	−	−	−	−	−	−	−	−	0
16	J.N.	6	8	+	+	+	−	+	−	+	+	+	−	−	−	0
17	L.	9	8	+	−	+	−	−	−	−	−	−	−	−	−	0
18	R.	9	7	+	+	+	+	+	+	−	−	−	−	−	−	0
19	S.	9	8	−	−	−	−	+	−	−	−	−	−	−	−	0
20	L.	9	7	+	−	−	−	−	−	−	−	−	−	−	−	0
Totals.				16	6	10	3	12	2	2	2	3	1	3	3	

A = Before treatment. P = After treatment. T = Total dose.

approach to this disease must consider these varying possibilities and it seems probable that a combination of a small course of Emetine with the oxy-quinolin sulphonic acid group of drugs should most nearly approach the ideal form of treatment at present available, and should be followed by fewer relapses than when either one is used alone. The final evaluation of any method of ridding the host of this infection cannot well be carried out under field conditions in the tropics where the disease is so common and where the possibility of constant reinfection cannot be avoided.

CONCLUSIONS

1. The preparation of iodo-oxy-quinolin sulphonic acid marketed under the trade name of Anayodin was used in the treatment of seven acute and chronic cases of amoebic dysentery and 23 chronic cyst passers. In both groups it eliminated promptly the Endamoeba histolytica from the stools.
2. Seventeen cases reexamined from 10 days to two months after treatment disclosed no evidence of amoebic infection.
3. The preparation appeared to be relatively ineffective against other intestinal protozoa.

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TREATMENT WITH DI-HYDRANOL OF INTESTINAL PROTOZOAL AND HELMINTHIC INFECTIONS IN MAN

A Preliminary Report

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Di-hydranol (Heptylresorcinol or 2-4 dihydroxyphenyl n-heptane) is an antiseptic which was developed by V. Leonard in 1924. His experiences and those of subsequent observers with this drug as an intestinal disinfectant for protozoa, bacteria, and helminths in man and laboratory animals, have led to the following observations which were carried out at the request of the General Manager of our Medical Department.

The compound, which is described as a yellowish crystalline powder, was administered in gelatine capsules each containing 0.15 gram of the drug dissolved in olive oil. Its toxicity has been described as clinically negligible, and our experience confirms this. There was encountered, in some instances, slight intestinal disturbances (constipation), but only occasionally were these accompanied by gastric or abdominal discomfort. A cumulative effect was apparently absent, as up to 17.55 grams were taken in a single treatment series without untoward symptoms.

Our chief interest was naturally directed towards the drug's effect on the Endamoeba histolytica in all its stages, since this parasite is the most prevalent as well as the most pathogenic intestinal protozoon met with in the population of this locality. There are, however, two other parasites of the intestinal tract which, in the writer's personal experience, if encountered as heavy infestations, are apt to produce intestinal and general symptoms in the carrier. I refer to Giardia lamblia and Strongyloides stercoralis, both of which are not infrequently encountered here. They have been a veritable crux to the writer, on account of their resistance to all of the known methods of treatment which have been tried. Whereas the effects of Di-hydranol in the treatment of intestinal flagellate infection has been made public previously—E. C. Faust (Proceedings of the Society for Experimental Biology and Medicine, 1931, XXVII, Pages 905 to 907) treated 11 cases of Giardia lamblia in humans and eliminated two of the infections; while Ratcliffe (American Journal of Tropical Medicine, Volume XI, July, 1931, No. 4) reported recurrences in all four cases of humans infested with this protozoon—we believe this report to be the first account of its use in the treatment of Strongyloides infestation.

In addition to the study of the two protozoal infections just named, we have included a record of the behavior of helminthic parasites under Di-hydranol treatment as it has been described as an effective ascaricide (Lamson, Caldwell, Brown and Ward, American Journal of Hygiene, 1931, Vol. 13, No. 2).

The series treated up to the time this report was rendered comprised 31 male adults, many of whom were infested with several different kinds of protozoal and helminthic infections at the same time. One individual was found harbouring six different parasites; in fact, he carried the entire list comprised in this series. Ranked in the order of frequency of their occurrence, they were as follows: Endamoeba histolytica, 28 cases; Uncinaria, 23; Trichocephalus, 22; Lamblia, 21; Strongyloides, 7; and Ascaris, 4.

Among the 28 patients infested with Endamoeba histolytica, only three presented dysenteric symptoms; while the other 25 cases were carriers without well-defined symptoms.

The drug was administered usually in increasing dosage, beginning with 0.9 gram daily (6 capsules) and terminating with 1.8 grams (12 capsules) daily, given in divided doses 3 times a day after meals. The maximum dosage of 12 capsules daily was usually reached on the third day of treatment, and was then continued for a number of days which varied according to the results obtained.

With very few exceptions, careful examinations of the fresh stools were made daily in each case.

As we pointed out in a previous report (Nineteenth Annual Report), it is a difficult problem under local conditions to estimate the number of "cures" of amoeba carriers among those cases which we treat; as we have to base our data on the effects observed in our patients while under observation in the hospital. Once they have left the institution, they are exposed to conditions conducive to reinfection, over which our control is only partial; and it is extremely difficult to follow the cases for observation.

The immediate results obtained were divided into three classes—"Good," "Satisfactory" and "Poor." Under the heading "Good" are grouped those cases which showed consistently negative stool examinations after the treatment was under way; "Satisfactory" designates those cases which showed a tendency to relapse under treatment but which finally became negative; and "Poor" includes those who were still positive after what was thought to be a reasonable period of treatment.

TABLE I

ENDAMOEBA HISTOLYTICA

	Results			
	Good	**Satisfactory**	**Poor**	**Total**
No. of cases	17	4	7	28
Largest amount given	72 caps. (2 cases)	75 caps. (1 case)	105 caps. (1 case)	
Smallest amount given	21 caps. (1 case)	60 caps. (1 case)	39 caps. (1 case)	
Average amount given	47 caps.	68 caps.	62 caps.	
Average effective dose until stools became negative	16 capsules		—	
Heavy infections (3 plus)	2	—	5	7
Very light infections (1 plus)	7	2	—	9
Cysts appearing under treatment	2	1	6	9 (32%)

Remarks: 3 of the 28 intestinal amoebiasis cases presented symptoms of amoebic hepatitis. The Di-hydranol treatment had no obvious effect in relieving the hepatitis; but emetin was given to these cases, after concluding the Di-hydranol treatment, and the usual prompt response was observed.

TABLE II

OVA OF UNCINARIA

	Results			
	Good	**Satisfactory**	**Poor**	**Total**
No. of cases	1	2	20	23

Remarks: Of interest in this series, which proved beyond doubt the refractory behaviour of Uncinaria towards Di-hydranol dissolved in oil, is the fact that in some instances the eggs made their first appearance in the stools as late as the sixth stool examination.

TABLE III

OVA OF TRICHURIS TRICHIURA

	Results			
	Good	**Satisfactory**	**Poor**	**Total**
No. of cases	5	4	13	22

Remarks: The action of Di-hydranol on this stubborn but rather innocuous parasite is in line with the rather indifferent results obtained from other helminthics which we have used.

TABLE IV
GIARDIA LAMBLIA

	Results Good	 Satisfactory	 Poor	Total
No. of cases	12	2	7	21
Largest amount given	Over 100 caps. (2 cases)	73 caps.	Over 100 caps. (1 case)	
Smallest amount given	21 caps. (1 case)	52 caps.	39 caps. (1 case)	
Average amount	58 caps.	63 caps.	60 caps.	
Average effective dose until stools became negative	18 capsules		—	
Heavy infections (3 plus)	4	2	2	8
Very light infections (1 plus)	5	—	1	6

Remarks: The results obtained with Di-hydranol in flagellate infections of the bowels compare favourably with any other form of treatment for this condition. The intestinal flatulence, which frequently accompanies the Lamblia infection, disappeared under Di-hydranol treatment; even in those cases whose stools remained positive. This observation confirms the writer's previous personal experience with resorcinol in the treatment of intestinal putrefaction not associated with flagellate infection.

TABLE V
STRONGYLOIDES STERCORALIS

	Results Good	 Satisfactory	 Poor	Total
No. of cases	5	2	0	7
Average effective dose until stools became negative	30.5 caps.	15 caps.	—	

Remarks: The writer holds little doubt that the diarrhoea, abdominal distress, general malaise and a more or less pronounced anemia often found in patients harbouring stercoralis are directly connected with the presence of this parasite. The results obtained with Di-hydranol in this condition were by far superior to those gotten with any other drug which we have heretofore employed in the treatment of this infestation.

TABLE VI
OVA OF ASCARIS

	Results Good	 Satisfactory	 Poor	Total
No. of cases	3	1	—	4
Average effective dose	10 caps.	57 caps.	—	

Remarks: This series, although few in number, has been included, as it confirms the favourable results reported by the first observers.

SUMMARY

Di-hydranol, a resorcinol derivative, was employed in the treatment of 105 individual intestinal infections encountered in 31 male adults. It was administered in a solution of olive oil in gelatin capsules.

Uncinaria (23 cases) and Trichuris trichiura (22 cases) generally proved refractory to the drug, whereas 4 cases of ascariasis showed a good response.

Di-hydranol proved itself of decided value in the treatment of 28 carriers of E. histolytica. Three-fourths of the infected cases became negative under treatment. Five of the seven cases which showed unsatisfactory results were very heavily infected, though none of them showed any acute dysenteric symptoms. The clinical response in three cases with acute dysenteric symptoms was very satisfactory. Thirty-two per cent of the cases developed cysts during the treatment; and the effect of the drug upon these was poor, as 6 out of 9 remained positive.

Very encouraging immediate results were obtained in Giardia lamblia infections—in 14 of the 21 cases the stools became negative. Of the 19 instances in which patients showed co-existing infections with Endamoeba and Lamblia we succeeded in freeing the carriers from both infections in eight instances.

The 7 cases of infection with Strongyloides yielded, without exception, to Di-hydranol.

DI-HYDRANOL IN THE TREATMENT OF INTESTINAL PROTOZOAL INFECTIONS

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Investigation of the antiseptic properties of the higher alkylresorcinol compounds developed by Leonard and his associates has led to their trial as therapeutic agents for intestinal protozoal infections. While these organisms, with the exception of the Endamoeba histolytica and Balantidium coli, are usually considered harmless commensals in man, any non-toxic preparation effective against the various human infections would be an important addition to therapy. Ratcliffe[1] showed that certain of these substances altered the intestinal flora from the gram positive to the gram negative type and that they eliminated the intestinal protozoa found in rats and young chicks. Heptylresorcinol, or di-hydroxyphenyl N-heptane, was then prepared for clinical trial in man under the name of Di-hydranol.[2] In crystalline form it is a light yellow, waxy substance with a melting point of about 70 degrees. It has a pungent odor and when placed on the tongue causes a burning sensation followed by mild anaesthesia. It is sparingly soluble in water but readily so in alcohol and in vegetable oils. The greater part of the drug is eliminated by the bowel but small amounts may be recovered from the urine. Leonard states that no toxic effects occur in man or in laboratory animals when upwards of three grams are taken daily, but in concentrated form it is too irritating for the human stomach. David and Leake[3] found it lethal for guinea pigs in doses of 400 mgs. per kilo of body weight when given orally in a single dose. The animals died in about four days with loss of weight, diarrhoea, and lethargy. Continued administration at lower dosage, however, seemed to be curative in the natural infections of Balantidium in these animals.

Clinical trials in man have had contradictory results. Faust[4] first studied the effect of this preparation in human infections. It was given in amounts of from four to ten grams, dissolved in olive oil which eliminated the irritating effects, the daily dosage varying from 0.6 to 0.9 gram. While no significant evidence of toxic action resulted, slight gastric pain occurred in two children, and two adults developed a transitory diarrhoea. His experience led him to the conclusion that the drug was specific for Endamoeba histolytica, Iodamoeba butschlii, and Endolimax nana. He reported thirteen cures among fourteen histolytica infections. Endamoeba coli, Chilomastix mesnili, and Giardia lamblia, however, proved less amenable to treatment. Ratcliffe, also, used Di-hydranol in the treatment of intestinal infections in both man and monkeys. The human cases, however, were limited to infections by the less important forms. The drug was given in 25% olive oil solution administered in gelatin capsules each containing 0.15 gram of Di-hydranol. He obtained cures in one case each of infection by Trichomonas hominis, E. coli, I. butschlii, Chilomastix mesnili and Pentatrichomonas, with a total dosage varying from 9 to 15 grams. Failures occurred with lesser amounts in one case each of E. coli and I. butschlii, four cases of Giardia and two cases of Trichomonas. When given in agar as well as in oil he found it effective in clearing up infections with the pathogenic amoebae and Balantidium in monkeys. Reed[5] and his co-workers, however, found no indication of therapeutic value in the treatment of six cases of human amoebiasis although the drug was used in the dosage recommended.

Through the courtesy of Dr. Veador Leonard it was possible to make further clinical trials at the Quirigua Hospital (Guatemala) during the summer of 1931. The preparation was supplied in the form of pills each containing 0.15 gram of Di-hydranol enclosed in a shell-like sugar coating. They are said to break up rapidly in the stomach and duodenum and in consequence were expected to be most effective upon the forms inhabiting the upper portion of the small intestine. The standard dose for adults was four pills, 0.6 gram, three times daily after meals for eight consecutive days. For children this was modified according to Young's rule in the fear that the adult doses would not be well tolerated. No evidence of toxic effect was noted, and no case of diarrhoea developed under treatment. In only one instance were subjective symptoms produced. An adult male heavily infected with Giardia lamblia was given a total of 20.7 grams in the course of nine days. He complained of some epigastric burning about half an hour after meals and at times of slight abdominal cramps. These symptoms, however, were not severe and did not require withdrawal or alteration of the dosage.

The cases selected for this study were individuals infected with the intestinal flagellates. For the most part they were ambulatory and could not be hospitalized. While the administration of the drug was regular and observation during the treatment period sufficiently close to detect any toxic phenomena, it was not possible to obtain regular daily stools for examination. In so far as was practicable two specimens were obtained after treatment for follow up observations but this was not accomplished in every case. The number of such re-examinations and the interval after the end of treatment were insufficient to afford convincing evidence that the apparently cleared cases were actually cured of their infections. As was the case in the amoebic group, the diagnosis was made from fresh stools using an iodine and a saline preparation. The later examina-

TABLE 1

GIARDIA LAMBLIA

Di-hydranol Pills Each 0.15 gm.

No.	Name	Age Yrs.	Days of Rx	Total Dose—gms.	Organisms Present—Day of Rx								Findings in Follow-up		
					1	2	3	4	5	6	7	8			
1	J.N.	10	8	6.6	+								7d +	2½w +	+
2	L.N.	7	8	6.6	+				+				7d −	2w +	+
3	M.	6	10	4.2	+		−		−		−				
4	A.	26	9	13.8	+	+	+	+	+	+		+			
5	M.	35	8	14.4	+	−	−	−	−	−		−	5d −	2w −	−
6	M.	35	8	13.8	+								2d −	2w −	−
7	M.	3	7	5.4	+	+			−			−	1w −	2w −	−
8	A.	4	7	5.7	+				+				1d +	4d −	2w +
9	E.B.	6	9	8.7	+		+			+	+	+	1d +	2w +	+
10	S.B.	2	9	5.1	+				+			+	2d −	2w +	+
11	I.B.	36	7	10.2	+								1d −	4d −	2w +
12	E.B.	4	9	6.0	+	+			+		+	+	2d +	2w +	+
13	C.S.	13	8	10.65	+	+			−				2d −	5d −	−
14	E.S.	10	8	9.9	+	+	+		+			+	1d +	2w +	+
15	L.	6	8	7.5	+	+	+	+			+	−	2d +	2w +	+
16	Z.	Adult	9	20.7	+		−	−	−	−		−	*		
17	F.S.	15	5	7.8	+	+							1d −	1d +	+
18	S.	1½	4	3.0	+	+		+	+						
19	S.		9	11.7	+			−	−	−	−	−			

19 cases: 10 positive p Rx; 4 negative p Rx; 5 s̄ follow-up—of these 2 failed to become negative during treatment.

* = Some abdominal cramps, epigastric, ½ hr. P.c.

d = Days after the end of treatment.

w = Weeks after the end of treatment.

tions were carried out with the same technique. The results obtained were not comparable to the favorable reports of Faust and Ratcliffe.

Nineteen cases of infection by the Giardia lamblia were treated. (Table 1) Ten of these were found still to be harboring the organisms after treatment was completed. The majority of these individuals, however, were children who received only relatively small amounts of the drug. The largest total dose given in this group was 10.65 grams distributed over eight days. Four individuals appeared to respond favorably and their stools were negative in the two later examinations. Two of these cases were adults who received 14.4 and 13.8 grams respectively; one was a thirteen year old boy who had taken 10.65 grams; and the fourth was a child who received only 5.4 grams.

TABLE 2

CHILOMASTIX

Di-hydranol Pills Each 0.15 gm.

No.	Name	Age Yrs.	Days of Rx	Total Dose—gms.	Organisms Present—Day of Rx								Findings in Follow-up		
					1	2	3	4	5	6	7	8			
1	A.R.	6	6	2.4	+			−	−	−					
2	O.	14	8	13.8	+									14d −	
3	B.	24	8	13.8	+	−	−	−					7d +	2w −	+
4	Giardia L.N.	7	8	6.6	+		−		−	−	−	−	7d −	14d −	
5	Giardia J.N.	10	8	6.6	+		−		−	−	−	−	7d −	3w −	
6	D.	12	7	9.0	+	−	+		−		−	−		2w −	
7	B.	1½	8	2.4	+		−	−	+	−			6d +	2½w −	+
8	Giardia B.	36	7	10.2	+									2½w +	+
9	O.		5	6.6	+				−						
10	Giardia A.	4	7	5.7	+		−		+				3d −	14d +	+

10 Cases: Four positives in follow-up; four negatives in follow-up; two follow-ups not obtained.
d = Days after the end of treatment.
w = Weeks after the end of treatment.

Five of the patients who had been treated failed to bring stools for follow up study. Two of them, however, continued to pass Giardia cysts throughout the treatment period and presumably were little benefitted. One who received 11.7 grams of Di-hydranol and one who had only small doses of the drug had negative stools at the examinations while under observation.

If the apparent cures are accepted as real, it appears that small doses of the drug have little promise of clearing the infection. The adjustment of the dosage according to Young's rule results in too small a total and in failure of treatment in most instances. With one exception the cases apparently cured had received more than ten grams in the eight-day period.

Ten cases of Chilomastix mesnili infection were similarly treated. (Table 2) Four of them were found to be passing the organisms when reexamined subsequently, four appeared to be cured and two failed to supply stools for later study. In this series the relationship of the total dosage to the end results is less clear. Two of those whose infections persisted received more than ten grams, and two had smaller doses. The four who seemed to be effectively treated, with one exception, received less than this amount.

The action of Di-hydranol on the other intestinal protozoa (Table 3) seems equally uncertain. Two patients who received respectively 6.6 and 13.8 grams were found to be passing cysts of Endamoeba histolytica after treatment.

TABLE 3

Di-hydranol Effect on Other Protozoa

No.	Name	Age Yrs.	Days of Rx	Total Dose—gms.	E.H.		Coli		Nana		Butschlii		Tricho-monas	
					A	P	A	P	A	P	A	P	A	P
1	J.N.	10	8	6.6	−	+	+	+	+	−	+	−		
2	A.O.	14	8	13.8	−	+	+	+						
3	L.N.	7	8	6.6			+	−	+	+				
4	M.	35	8	14.4			+	−						
5	I.B.	36	7	10.2			+	+	+	+				
6	G.S.	13	8	10.6							+	−		
7	L.	6	8	7.5					+	−	+	−		
8	A.	4	7	5.7									+	−
9	F.S.	15	5	7.8							+	−		
10	B.	24	8	13.8			+	+	+	+	+	−		
11	D.	12	7	9			+	+	+	−	+	−	+	+
12	B.	1½	8	2.4			+	+					+	+
					0	2	8	6	6	3	6	0	3	2

A = before treatment.
P = after treatment.

Eight cases who were carrying Endamoeba coli were given amounts of the drug varying from 2.4 to 14.4 grams. Six of these infections persisted and there was no correspondence in the dosage given to those that responded favorably. Of six individuals carrying the Endolimax nana, three continued to pass the characteristic cysts. Again the results obtained seemed to be accidental since the two who received the largest doses were not relieved. Iodamoeba butschlii responded well since neither cysts nor free forms were found subsequently. Trichomonas hominis persisted in two of the three infected individuals.

SUMMARY

In ten of fourteen cases reexamined twice after a brief interval following treatment, Giardia lamblia infection persisted. Only one of these ten had received a total dosage in excess of ten grams. Only one of the four who were apparently cured received less than ten grams. While the results achieved with the Chilomastix infections appear better, the lack of correspondence between the dosage and the clinical result leads one to believe that further examinations would have revealed a considerably higher percentage of persistent infections. Similarly the value of the drug in individuals harboring Endamoeba histolytica, Endamoeba coli, Endolimax nana, and Trichomonas hominis appeared slight. All cases of Iodamoeba butschlii seemed to respond favorably.

CONCLUSIONS

1. Di-hydranol in doses up to 20 grams in nine days for adults, and in proportion for children, was well borne and not associated with the development of toxic symptoms.
2. Its effectiveness against Giardia lamblia appears to vary directly with the dosage since only the larger amounts resulted in apparent cure.
3. When given to children in proportion to age, the total amount appears to be insufficient for therapeutic purposes.
4. Di-hydranol has little or no effect on other intestinal protozoa with the possible exception of Iodamoeba butschlii which seems to be susceptible to its action.

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EXPERIMENTAL STUDIES ON CHAGAS' DISEASE IN PANAMA*

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The recent discovery of Chagas' disease, or human trypanosomiasis, in Panama has aroused considerable local interest. Twenty-seven years of clinical and pathological records of the Panama Canal have shown no entry of a case of Chagas' disease; and the senior author's experience in field surveys for malaria in five mainland and three island countries of the Caribbean Sea during a period of three years did not reveal a case, although over 65,000 men, women and children were examined.

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Nevertheless, the same character of field surveys conducted in the mid basin of the Chagres River from December 1, 1930 to August 20, 1931 have accidently disclosed the presence of 5 human cases of Chagas' disease.

Our studies have consisted of searching for *Trypanosoma cruzi* Chagas in blood smears taken from many children during malarial surveys, examination of the blood of numerous animals for trypanosomes and subsequent inoculations to other animal hosts, and the collection of a number of *Triatoma geniculata* Latr., the arthropod believed to be the principal invertebrate host of the disease in Panama, with observations on the infection of these insects with trypanosomes.

TRYPANOSOMAL INFECTIONS IN CHILDREN

On December 1, 1930, the first case of human trypanosomiasis or Chagas' disease, to be recognized as such in Panama, was found in an infant, Eulalia Bonilla, who was admitted as a patient to the Santo Tomas Hospital, in the city of Panama. This case and two others, Theodosia Romero and José Romero, which were discovered about three months later, have been reported by Miller (1).

A fourth case was discovered on March 2, 1931. This was a child, Felix Ortega also from the village of Aguas Buenas, where the two Romero children lived, thus making 3 cases from this village. The Bonilla child lived in a hut situated about 2 miles from Aguas Buenas. The two places from which these 4 cases came are only a short distance from the highway that extends from the Canal Zone to the site of the proposed Madden Dam on the upper Chagres River.

A fifth case was found on August 20, 1931. This was a ten-year-old colored girl, Miriam Williams. She was of Jamaican parentage but had been born in Panama City. When the Canal Zone lands were opened to settlers in 1923 this family leased and moved to a small farm along the Chiva Chiva trail about 4 miles from the main Canal Zone highway. The child has lived there since that time and has been attending the Canal Zone school at Red Tank. On August 3 she was ill with fever and unable to attend school. An eruption which the mother considered to be measles occurred and lasted about three days. The fever still prevailed when the thick blood film in which the trypanosomes of this case were found was made on August 19. There were 41 trypanosomes present in the first film. This case lived approximately 10 miles in an air line from where the other 4 cases lived. The trypanosomes demonstrating the infection in the Ortega, Romero and Williams cases were first found in thick blood films taken during routine monthly blood examinations for malaria.

ANIMAL INOCULATIONS FROM HUMAN CASES

Animal inoculations were made from the Bonilla and Romero cases. Rabbits, guinea pigs and white rats were inoculated with blood from the Bonilla child on the day following the discovery of her infection with trypanosomes. Thick drop blood smears from the child on this day averaged 22 trypanosomes to a slide.

Rabbits 1 and 2. On December 2,1930, these two medium-sized, adult rabbits were each inoculated intraperitoneally with 0.5 cc. of blood from the Bonilla child. Both animals became positive on December 10 with trypanosomes present in moderate number in their blood on that date.

Guinea pigs 20, 21 and 22. On December 2, 1930, each of these 3 pigs was inoculated intraperitoneally with 0.5 cc. of blood from the Bonilla child. Guinea pigs 21 and 22 became positive on December 11 but No. 20 did not show trypanosomes in daily blood films until December 19.

White rats 16 and 17. On December 2, 1930, these 2 rats were each inoculated intraperitoneally with 0.5 cc. of blood from the Bonilla child. Rat 16 became positive on December 11 and trypanosomes appeared in the blood of No. 17 on December 12.

On March 13, 1931, guinea pig 79 was given an intraperitoneal injection of 1 cc. of blood taken from José Romero and guinea pig 80 received 1 cc. of blood from Theodosia Romero. Neither of these pigs ever became positive for trypanosomes. On the day the 2 pigs were injected the blood of each of the Romero cases was showing but 2 trypanosomes to a thick drop smear. These 2 cases seemed to be very light infections and the daily blood smears from them never showed more than 1 or 2 trypanosomes to a slide.

The Williams child (case 5) was brought to Gorgas Hospital on August 21, 1931, the second day after trypanosomes were discovered in her blood. On September 2, 2 guinea pigs and 1 white rat were each inoculated intraperitoneally with 2 cc. of blood taken from the patient's arm. No trypanosomes were found in the peripheral blood on this day. These 3 animals all become positive with trypanosomes present in their peripheral blood on September 22, after an incubation period of approximately twenty days. Since this article was in course of preparation at this time, these animals are not included in any of the tables, totals or percentages given later in this paper and they receive no further mention in the following pages.

TRANSFER OF HUMAN STRAIN FROM ANIMAL TO ANIMAL

On January 15, 1931, guinea pigs 29 and 30 were each inoculated intraperitoneally with 0.5 cc. of heart's blood from guinea pig 20. At this time the peripheral blood of guinea pig 20 was showing about 22 trypanosomes to a thick smear. Guinea pig 29 became positive on February 7 and guinea pig 30 on February 12.

On February 10, 1931, guinea pigs 38 and 39 were each injected intraperitoneally with 0.3 cc. of blood from heart of guinea pig 20. Both these guinea pigs became positive, No. 38 showing trypanosomes in its blood on February 15 and No. 39 on February 27. There were about 12 trypanosomes in a thick film of blood from guinea pig 20 on the day these inoculations were made.

On January 20, 1931, a marmoset monkey, *Leontocebus geoffroyi* (Pucheran) and a five-toed armadillo, *Cabassous centralis* (Miller), were each injected intraperitoneally with 0.7 cc. of blood from guinea pig 21. The blood of this guinea pig was showing about 6 trypanosomes to a thick film on this date. The monkey became positive on February 4th but the armadillo never showed any infection.

On July 24, 1931, a juvenile (one-fourth grown) four-toed armadillo, *Dasypus novemcinctus fenestratus* Peters, was inoculated intraperitoneally with 0.7 cc. of blood from the heart of guinea pig 39. The blood of this guinea pig was showing 26 trypanosomes in a thick film on this date. This armadillo died on August 13, but since it never showed trypanosomes in its blood and its death was due to other causes this inoculation has been considered as a negative one.

Six bats, 2 *Phyllostomus hastatus panamensis* Allen and 4 *Hemiderma perspicillatum aztecum* (Saussure), that were collected in the Chilibrillo Caves and had given negative results in daily blood examinations for seven days were inoculated intraperitoneally with heart's blood from guinea pig 22 on January 21. The blood of this pig was showing an average of 5 trypanosomes to a thick film on this date. Each bat received approximately 0.3 cc. of the pig's blood. None of these bats became positive during the following twenty days and at the end of that time they were inoculated with another strain. Details of this reinoculation are given in a later page.

Five of the bats that had remained negative after inoculation with the dog strain on January 21 were reinoculated with the Bonilla strain on February 10. Each of these bats was inoculated intraperitoneally with 0.3 cc. of heart's blood from guinea pig 20, the blood of which was showing 12 trypanosomes to a thick film on this date. Three of these bats failed to show any infection. The other two, both *Hemiderma perspicillatum aztecum* (Saussure), became positive. One, No. A. B. 5, showed a trypanosome in its blood on February 25. The second bat, No. A. B. 12, revealed 1 trypanosome in its blood on February 13 and another was found on February 25.

NATURAL INFECTION IN DOG

A few days following the discovery of the Bonilla case a visit was made to the house from which the child came. Blood films from two other children, one about two years and the other three years of age, were taken at this time. These films gave negative results upon examination. Several days later, on December 13, 1931, this house was again visited and blood films taken from two puppies and a kitten that were at the house. Upon our return to the laboratory these films were examined and it was found that one of the puppies was heavily infected with trypanosomes. The other puppy and the kitten were negative. On the afternoon of the same day the 3 animals were brought to this laboratory. The puppies appeared to be about three or four months old and were greatly emaciated and weak. The kitten was in the same poor condition as the puppies and this probably was due as much to insufficient food as to other causes. Thick blood films from the infected puppy, No. 1, showed about 150 trypanosomes to a slide at this time. Both of these puppies died on December 15, two days after being brought to the laboratory. The kitten was kept under observation for several weeks but no trypanosomes were found in its blood during this time.

From the literature at hand we are unable to find any previous report of a natural infection of Chagas' disease in a dog and we believe that this is the first instance of the kind.

TRANSFER OF DOG STRAIN TO OTHER ANIMALS

On December 14, 2 white mice, 2 white rats and 2 guinea pigs were each inoculated with blood taken from the jugular vein of infected puppy 1. The mice and rats each received 0.5 cc. of blood and the guinea pigs were each given 1 cc. All 6 animals became positive and showed trypanosomes in their blood. One mouse was positive in ten days and the other in sixteen days. The 2 rats became positive in nine and eleven days and the guinea pigs in three and four days.

On January 21, 2 guinea pigs were each inoculated intraperitoneally with 1 cc. of blood from the heart of white rat 22. This rat was one of those infected through inoculation with blood from puppy 1. These 2 guinea pigs showed trypanosomes in their blood in fourteen and fifteen days after inoculation.

Three bats, *Hemiderma perspicillatum aztecum* (Saussure), that had shown no natural infection of trypanosomes in their blood during seven days after capture were each inoculated with 0.6 cc. of blood from the heart of white rat 22 on January 21. There were 5 trypanosomes present in a thick film of blood from the rat on this date. Two of these bats never showed any infection. One trypanosome was found in a blood film from the third bat, No. A. D. 6, on February 10.

NATURAL INFECTION IN ARMADILLOS

Chagas (2) and Torres (3) have found trypanosomal infections in the armadillos in Brazil. The trypanosomes present in these animals appeared to be indistinguishable from *Trypanosoma cruzi* and have been accepted as being that organism. Three species of the Brazilian armadillos appear to acquire this through natural infection. Chagas (4) found that from 46 to 50 per cent of the species, *Dasypus novemcinctus*, were infected. This species differs from our common armadillos, *Dasypus novemcinctus fenestratus* Peters, only in subspecific differences and through geographic distribution. We were fortunate in being able to find that a number of our Panama armadillos were also infected with a trypanosome morphologically similar to those found in the human cases and we have no hesitancy in recording it as *T. cruzi*.

During the past thirteen months a total of 28 armadillos, 25 *Dasypus novemcinctus fenestratus* Peters and 3 *Cabassous centralis* (Miller), have been received alive at this laboratory. The blood of twenty-four of these animals was examined daily by the thick film method during a period of seven or more days. The other four died or were killed in less than seven days, two being sacrified three days after being received and two died on the fifth day. Six, or 21.4 per cent, of these animals, all *Dasypus novemcinctus fenestratus,* were found to be infected with trypanosomes.

Armadillo 1. Received on August 12, 1930. Had been captured near Arraijan. A trypanosome was found in one of its daily blood smears on August 20, eight days after being received. The animal died on August 21. Smears of heart's blood taken at autopsy showed trypanosomes. The infection in this armadillo was found before the first case of human trypanosomiasis was discovered in Panama.

Armadillo 18. Was captured near Patuga, in the Province of Herrera, and was brought to the laboratory on July 1, 1931. One trypanosome was found in its blood on July 5. It was sacrificed on July 9. A thick film of post-mortem blood was positive for 2 trypanosomes.

Armadillo 20. This animal was received on July 14 from Parita, Province of Herrera. A thick film of its blood taken on July 15 contained 15 trypanosomes. A gradual increase in the number of trypanosomes in the blood seemed to occur until ninety-nine were present in a thick film taken on July 23. Its post-mortem blood showed many trypanosomes in both thick and thin films.

Armadillo 21. Received on July 14 from Parita. A thick blood film taken from this animal on July 15 contained 25 trypanosomes. This number increased until seventy-five could be found on July 21. Many trypanosomes were present in the post-mortem blood of this animal after it was killed on July 23.

Armadillo 23. Captured near Parita and brought to the laboratory on July 14. One hundred and fifty trypanosomes were found in a thick film of its blood on July 15, one or two being present in each microscopic field. This animal was killed on July 23. Trypanosomes were present in each microscopic field of the thick film of blood taken from the animal's heart at autopsy.

Armadillo 25. This animal was brought to the laboratory on August 8. It had been captured near Patuga. A thick blood film taken from this armadillo on August 10 showed 6 trypanosomes. This number increased to thirty-one to a film by August 16. This armadillo died on August 18. Blood films taken at autopsy showed 52 trypanosomes to a thick film and three to a thin film.

It was interesting to note that of the positive armadillos only one could be considered an adult. This was No. 18 with a comparatively light infection. The other five were juveniles and apparently not more than one-quarter grown. Three of the latter were part of a batch of five that were captured near Parita and since the five were about the same size they probably all belong to the same litter. The other two of the batch showed no trypanosomes.

The two villages of Parita and Patuga, in the Province of Herrera, where five of the positive armadillos were caught, are hardly more than 4 miles apart.

The daily increase of the trypanosomes in the blood of four of these juvenile armadillos following their capture was rather striking and leads one to wonder regarding the cause of it. It may have been due to an effect produced on the animal through being handled, lack of proper food or by other abnormal conditions caused by their captivity.

The foregoing observations on the infection in armadillos cause us to suspect that a great many of the armadillos in Panama become infected with trypanosomes while in the early juvenile stage and as they become older the infection is either thrown off entirely or the trypanosomes become so few in number that that they are seldom found in the peripheral blood unless something abnormal happens to the animals and causes a relapse.

ATTEMPTS TO TRANSFER ARMADILLO STRAIN TO OTHER ANIMALS

The only attempts made to transfer the armadillo strain of trypanosomes to other animals was the inoculation of 2 guinea pigs with blood from the heart of armadillo 1 on August 21, 1930. This blood was taken while the armadillo was in a moribund condition. Each pig received 0.5 cc. of the blood intraperitoneally. The pigs failed to show any positive results. The infection in this armadillo was a very light one.

NATURAL INFECTION IN OPOSSUMS

In 1929, Robertson (5) found an opossum, *Didelphis marsupialis,* naturally infected with a trypanosome that seemed to be *T. cruzi,* near Tela, Honduras. This appears to be the first report of a marsupial being infected with this trypanosome. A number of naturally infected local opossums of practically the same species were also found by us during our investigation. The trypanosome present in the blood of these animals resembled *T. cruzi* and we believe with Robertson, that it should be so recorded.

During the past seven months, 81 opossums, *Didelphis marsupialis etensis* Allen, were received at this laboratory and the blood of each one was examined. Owing to the existing conditions the number of daily examinations of each varied considerably. Twenty-five of the animals had been injured during capture and died or were killed so soon after arrival at the laboratory that only post-mortem blood was examined. Blood films for examination were taken from two on one day only, from twelve on two days, nine on three days, eleven on seven days, three on eight days and nineteen for periods ranging from eight to ninety days.

A total of twenty, or 24.6 per cent, of the 81 opossums examined was found to be infected with trypanosomes. The number present in the blood of these animals varied considerably and ranged from one to eighty-eight to a thick film. The greater number of the animals, however, showed only light infections.

Trypanosomes were found in blood films from eight of the animals that were killed on arrival and whose post-mortem blood only was examined. Of the others that remained alive one day or longer and which were found to be infected, 5 showed trypanosomes on the first day, 3 on the third day, 1 on the tenth day and 1 animal did not show a positive film until the twenty-first day after its arrival at the laboratory.

The infected opossums came from several locations. One was captured in the Chilibrillo Caves, about 1½ miles from Aguas Buenas. Another came from Summit, in the Canal Zone. Two were taken near Alhajuela, about 5 miles from from the Chilibrillo Caves. Ten were captured near Parita and six were brought from Patuga. Five of the positive animals were found in one lot of 14 opossums received from Parita on July 8, 1931.

NATURAL INFECTION IN BATS

Wenyon (6) informs us that bats naturally infected with trypanosomes have been found by various workers in Europe, India, Africa, South America, the West Indies and other parts of the world. Although some of the trypanosomes found in these bats closely resembled *T. cruzi* they, nevertheless, were believed to be different species.

The trypanosomes found in the bats of Panama are morphologically similar to *T. cruzi* and in our estimation should not be recorded as a separate species. There seems no reason to believe that bats are likely to have a trypanosome limited to the Chiroptera or that it would be incongruous for the latter to be infected with *T. cruzi.*

Therefore, as a result of our findings during these investigations, we feel quite confident that the trypanosomes found by us in the bats of Panama were *T. cruzi.* This conviction is due not wholly to the similarity of morphology of the trypanosome but also to the other circumstances involved. We found an infected opossum, many infected bats and numerous infected *Triatoma* in the same chamber of a cave and this cave was only a comparatively short distance from the habitations of the human cases. In addition, the trypanosome of the bat was transmitted to laboratory animals and we look upon this as evidence of considerable weight.

The blood of 161 bats have been examined during the past thirteen months and a total of thirty, or 18.6 per cent, was found to be infected with trypanosomes. The species represented by those examined and the number of each that were found infected are given below:

Hermiderma perspicillatum aztecum (Saussure). Seventy-five bats of this species were examined and eighteen, or 24 per cent, were found to be infected with trypanosomes. Fifty-five of those examined, including sixteen positives, were collected in the Chilibrillo Caves and twenty-one, with two positives, were taken from culverts beneath the highway at Bella Vista, suburb of Panama.

Phyllostomus hastatus panamensis Allen. Thirty-seven of these large bats were collected in the Chilibrillo Caves. Upon examination, eight, or 21.6 per cent, were found to be positives.

Uroderma bilobatum Peters. Fifteen of this species that were found hanging in trees at Summit were examined and one, or 6.7 per cent, showed trypanosomes in its blood.

Glossophaga soricina leachi (Gray). Thirteen of this species were examined.

Nine of these were found in a small detached building used for a private garage near a dwelling at Bella Vista and four were captured in a culvert beneath the roadway on the west side of the Canal, nearly opposite the Miraflores Locks. One of the number taken at Bella Vista proved to be positive, giving 7.7 per cent of positive findings for this species.

Artibeus jamaicensis jamaicensis Leach. Eight specimens of this robust bat were captured in palm trees at Summit. Two or 25 per cent, were positive.

Molossus sinaloae Allen. Thirteen of this species were collected in the attic of a house at El Real, in the Tuira River district. None in this lot was found to be infected.

One hundred and five of the 161 bats examined were chloroformed soon after their arrival at the laboratory and a thick and a thin film made from the blood of each one. The blood was obtained either by clipping the tip of an ear or drawing it directly from the heart with a hypodermic syringe. The bats were then usually killed in order that all ectoparasites could be collected. This resulted in the examination of but one thick film from each bat that was handled in this way. The remaining fifty-six bats were kept alive for some time for observation or experimental purposes and this allowed them to be examined daily over periods ranging from two to fifteen days or longer. Trypanosomes were found in twenty-three, or 76.6 per cent, of the infected bats during the examination of the first film from each. The infections in the other seven positives were discovered during later examinations that ranged from two to six days.

The number of trypanosomes present in the first positive slide taken from each infected bat varied from a single trypanosome to four hundred or more in a microscopic field of a thick film. One lot of thirty-four *Hemiderma perspicillatum aztecum* that was collected at one time in the Chilibrillo Caves contained twelve positives. These infections were all found during the examinations of the first films. Several of this lot showed heavy infections, one having more than four hundred in each microscopic field.

We do not consider it presumptuous to express the belief that the majority of the bats of Panama become infected with this trypanosome in early life and that many of them spontaneously recover to become chronic carriers of the parasite.

TRANSFER OF BAT STRAIN TO OTHER ANIMALS

Animal inoculations were made with the strain of bat trypanosomes and the infection was transmitted to white mice, white rats, guinea pigs and dogs.

White rats 1 and 2. On August 5, 1930, seven bats, *Artibeus jamaicensis jamaicensis,* were captured in a palm tree at Summit and brought to the laboratory. Two of these were adult females and five were juveniles, three males and two females, that apparently were slightly more than half grown. Approximately 0.3 cc. of blood was taken directly from the heart of each of the two adults and two of the juveniles and injected into the peritoneal cavity of rat 1. A second rat, No. 2, was inoculated in the same manner with blood from the other three juvenile bats.

Blood films taken from each of these bats showed an infection with trypanosomes in one of the adults. All of the others gave negative results. Rat 1 died August 16 before exhibiting any signs of infection. No. 2 became positive and showed trypanosomes in its blood on August 20, fifteen days after inoculation.

White rat 8. On August 23, rat 8 was inoculated intraperitoneally with 0.5 cc. of blood taken from the heart of infected rat 2. There was but one trypanosome to be found in a thick film of blood from the latter rat on this date. Rat 8 became positive and showed trypanosomes in its peripheral blood on September 6, after an incubation period of fourteen days.

Guinea pig 5. This pig was also inoculated with 0.5 cc. of heart's blood from rat 2 on August 23 and became positive on September 1.

White mice 18 and 19. On December 8 these 2 mice were each inoculated with 0.5 cc. of blood from the heart of guinea pig 5. The last date that trypanosomes had been found in the peripheral blood of this guinea pig was November 17 twenty days previously. Since that date the pig's blood was examined six times at intervals of from three to five days between examinations. No trypanosomes were found in these examinations and none were present in a blood film taken on the date of these inoculations. Both of these mice became positive for trypanosomes on December 22 and developed fairly heavy infections.

Guinea pig 25. This guinea pig was also injected with 1 cc. of blood from guinea pig 5 simultaneously with the inoculations of mice 18 and 19. Trypanosomes appeared in its blood on December 17.

Dogs 3 and 4. These dogs were about two months old and had been well cared for and were fat and in good condition. No. 3 weighed 9½ pounds and No. 4 weighed 11 pounds. They were both inoculated on January 17. No. 3 received 1 cc. of blood from the heart of guinea pig 25. No. 4 was given 0.5 cc. of blood taken from the heart of white mouse 18. Both of these inoculations produced positive results. Trypanosomes were found in the blood of dog 3 on February 5 and of dog 4 on January 27.

Wenyon (7) states that "Battaglia (1914) has claimed that *T. vespertilionis* is pathogenic to rabbits. He makes a similar claim for *T. lewisi.* No other observer has succeeded in confirming these statements, attempts at infecting laboratory animals with the trypanosomes of bats having invariably failed."

It may be noted from our success in infecting laboratory animals with the trypanosome of the bat that in Panama this organism is readily transmissible.

NATURAL INFECTION IN A SQUIRREL

A half-grown squirrel, *Sciurus gerrardi morulus* Bangs, had been kept as a pet for some time in the household of the Romero family, the two children of which were found to be infected with Chagas' disease on March 9. On March 30 this squirrel was brought to the laboratory and blood films taken from it for examination. A search of the first thick film showed eight trypanosomes. Daily blood films showed from two to six trypanosomes to a film until April 4 when the animal was placed on the survey list to be examined only at ten-day intervals. The examination of April 14 showed two trypanosomes to a film and on April 24 one was present to a film. This was the last date that the blood of the squirrel was found to be positive, although it was examined once every ten days during the subsequent four months.

The trypanosome in this squirrel was similar in morphology to *T. cruzi* and we have accepted it as such. We believe that it may have acquired its infection at approximately the same time as the 2 human cases in the house where this squirrel was secured.

INSECT VECTORS OF CHAGAS' DISEASE IN PANAMA

The insects that have been incriminated in the transmission of Chagas' disease in South and Central America belong to the family Reduviidae. This family is represented in Panama mainly by two members, *Triatoma geniculata* Latr. and *Rhodnius prolixus* Stal. Other species have been reported from this Republic but apparently they have been found only in small numbers. Neither of the two species that are commonly found here are present in abundance although they may be numerous in certain small areas.

Specimens of *Rhodnius prolixus* have been received from time to time by the junior author during a period of more than twenty years, but always in very sparse numbers. Three lots of from two to four each have been received from Capira. These were collected by a local resident who was engaged to search for them. Occasional specimens have been found at Ancon, in the Canal Zone, at Canete, in the Bayano River region and at Santa Rosa and San Juan, in the Chagres River valley. Two males of this species were also sent to this laboratory by the Bonilla family, one member of this family was the first human case of Chagas' disease to be found here. The two bugs were captured in or near the hut in which this family lives. Since we have not been able to secure *R. prolixus* in any numbers no studies have yet been carried out to determine their possible infection with trypanosomes in Panama.

In Brazil the *Triatoma geniculata* is found in the burrows of armadillos and it seems to be the belief there that these animals receive their infection from the bugs. If such is the case the infection is probably passed back and forth from the infected bugs to young animals and from the infected animals to bugs newly emerged from the eggs. Since we have not had opportunities for examining the burrows of armadillos in Panama we are unable to state whether or not they are infested with these bugs in this part of the world.

Only two specimens of *Triatoma geniculata* had been collected by us in Panama previous to the beginning of these studies in Chagas' disease. Both of these were taken from the outside of a house screen, one at Ancon and the other at Balboa, in the Canal Zone, during 1914. During the past few months we have also received two specimens from Santa Rosa and one from Aguadulce. The main source of our supply of *T. geniculata* that were used in these experiments was the Chilibrillo Caves that have been previously mentioned in the foregoing pages as a place where an opossum and numerous bats infected with trypanosomes were found.

THE REDUVID BUG, TRIATOMA GENICULATA, IN THE CHILIBRILLO CAVES

The Chilibrillo Caves are located in the extensive limestone ridge sloping along the Chilibrillo River, a tributary of the Chagres' River. They are hardly more than ½ mile from the new Madden highway that extends from the Canal Zone to the upper Chagres River. In air lines from these caves it is about 1 mile to the Bonilla house, 1½ miles to Aguas Buenas, 5 miles to Santa Rosa, 7 miles to Summit in the Canal Zone and 15 miles to Panama City.

The easily accessible parts of these caves consist of three large chambers and numerous tunnels, many of the latter being connected. The central chamber is a fairly dry, flask-shaped room approximately 185 feet in length and increasing from 20 feet in width near the entrance to 50 feet wide near the posterior wall. The roof is nearly hemispherical and at the highest part is hardly more than 12 feet from the floor of the cave.

At the beginning of the present year it was planned to carry out a rather complete survey of the fauna of these caves. This work was begun on January 15 and during the subsequent ten weeks Mr. A. L. Brody, Assistant Entomologist at this laboratory, accompanied by a West Indian boy, spent an average of three forenoons each week in collecting specimens of the fauna present in various part of the caves.

Bats of several species were present by the thousands and were hanging, either singly or in large groups from the roof and walls of the caves.

A total of ninety specimens of *Triatoma geniculata* was taken in these caves. Eighty-nine of these were collected in the central chamber described above, only one being found in the other parts of the caves. Eighty-five were taken in a small alcove on one side of this chamber about 50 feet from the entrance. The infected opossum, No. 1, was also found in this alcove.

The bugs were not found in abundance. From one to seven could be located on the walls each time the cave was visited. Seven was the largest number taken at one visit. Each visit represented approximately two and a half hours of searching by two collectors with the aid of electric flashlights. This leads us to believe that the bugs remain hidden within the numerous small crevices present in the walls of the cave during the greater part of the time and they are not seen on the walls except when they emerge in search of a meal of blood.

These bugs readily fed on bats in the laboratory and it is quite probable that under natural conditions in the caves they commonly obtain their blood meals from the bats as well as from other animals that may be present. Three opossums, however, were the only mammals other than bats seen in the caves during this survey.

Nine of the *Triatoma* collected were adults. The other eighty-one were immature forms that ranged from unfed larvae to last stage nymphs.

A report by Caudell (8) on insects collected in these caves in 1923 by Shannon, Zetek and Molino shows that specimens of *T. geniculata* were found there at that time. In view of this it is quite probable that this species of *Triatoma* has been present in the caves for many years.

TRYPANOSOMAL INFECTION IN TRIATOMA GENICULATA

Studies to determine the number of the *Triatoma* that might be infected with trypanosomes were carried out on the specimens collected in the caves. These studies consisted of (*a*) examination of the feces of the bugs, (*b*) inoculation of guinea pigs with macerated bugs and (*c*) feeding the bugs on guinea pigs.

Examination of the feces

Microscopic examinations were made of smears of feces from eighteen of the bugs. The smears were made from the material excreted soon after taking a meal of blood from a guinea pig. As a bug became replete and was removed from the guinea pig it was placed in a clean, short, wide-mouthed bottle. Excreta was usually discharged within a half hour after a bug was placed in the bottle and one or two slides was then prepared from this material. Trypanosomes were found in slides from ten out of the eighteen bugs, giving a result of more than 55.5 per cent of positives in the lot. Had smears been made and examined on more than one occasion from each bug it is probable that more positives would have been discovered.

Inoculation of guinea pigs with macerated Triatoma

Twenty-six of the bugs, representing the different nymphal stages as well as adults, were used in these inoculation experiments. Each bug was well macerated in a small amount of normal saline solution and the resultant emulsion injected into the peritoneal cavity of a guinea pig. This was done either on the day the bugs were collected or on the day following and without giving them any chance to feed while at the laboratory.

Five of these bugs had round abdomens and upon maceration each showed blood that appeared to be of fairly recent ingestion in the stomach or intestinal tract. Three were partly depleted and the contents of their alimentary canals were fairly well digested. Eighteen were quite flat and all material present in the intestines was thoroughly digested.

Twenty-one, or 80.8 per cent, of the 26 guinea pigs that were inoculated became positive, showing that the greater number of the *Triatoma* found in the cave were infected with trypanosomes.

Nothing of any importance could be noted in regard to the relation of the state of repletion of the bugs to their infectivity. One of the five nearly replete bugs gave negative results. Each of the three that were partly replete proved to be positive. The eighteen flat ones gave fourteen positives and four negative results.

Feeding Triatoma on guinea pigs

A number of the *Triatoma* were kept for use in life history studies that we began to carry out with this species.

In these studies each of the bugs was given an opportunity to feed on a guinea pig at intervals of every four days while in the immature stages and from two to four days for the adults. They were allowed to feed by placing each one in the bottom part of a small, round, cardboard pill box and the latter inverted on the shaven area of the abdomen of the guinea pig. The guinea pig was previously immobilized by bandaging it to a narrow strip of wood. A few turns of the bandage also served to hold the pill box firmly in place and prevent the escape of the bug. This arrangement placed the bug directly on the skin of the guinea pig with an opportunity for feeding in the dark. Three or four boxes, each containing a bug, were usually bandaged on a guinea pig at one time. Each box was left on the guinea pig from thirty to forty minutes.

Thirty-five bugs were used in these studies when they were started early in February. The mortality in this group was high and this number gradually decreased until but eleven were left at the end of June.

Each guinea pig was used as a host for a period of from four to six days. The total number of bites received by each guinea pig as well as the number of bugs that fed on each varied considerably, this depending entirely on the appetites of the bugs. Twenty-eight bites was the largest number definitely known to be received by one animal while seven was the smallest. None of the guinea pigs was bitten by all of the bugs during the period that it was used. Several of the bugs, however, fed two or more times on one animal. A positive bite was determined by the appearance of the bug when removed from the host. If much blood had been ingested, the effect of it was easily noticeable in the color, swelling, etc., of the abdomen of the bug. There was no way of determining, however, the number of times that a bug might have inserted its mouth parts in the skin and withdrawn them without feeding.

Daily blood examinations were made on the first 15 guinea pigs that were consecutively used in these studies. Seven, or 46.7 per cent, of these became positive and showed trypanosomes in their peripheral blood. The greatest number of bites to be received by one of the animals that became positive was twenty-two and the least number was eight.

In going over the literature on Chagas' disease and *Triatoma* one finds that a question exists in regard to whether the transmission of the disease to man or animal occurs through the bite of the bug or through contamination with feces that it deposits while feeding. In our studies the bugs were given the opportunity of resting directly on the skin of the host while feeding which would of course be nearly as favorable for infection by means of the excreta as by the bites alone.

Feces were occasionally noted on the skin, especially when a bug became greatly engorged and was left on the host for longer than thirty minutes. More frequently, however, the bugs did not discharge excreta until after they had been replaced in the bottles in which they were regularly kept. We have, therefore, no way of determining the manner in which the infection occurred in our pigs that became positive. It is planned to carry out investigations on this problem of transmission at a later date.

TABLE 1

Incubation period of T. cruzi in animals infected from various sources

Source of Inoculation	Animal Inoculated	Laboratory Animal Number	Incubation Period (days)
Human case 1 (Bonilla)	Rabbit 1		8
	Rabbit 2		8
	Guinea pig	20	17
	Guinea pig	21	9
	White rat	16	9
	White rat	17	10
Guinea pig 20 (first subinoculation)	Guinea pig	29	23
	Guinea pig	30	28
	Guinea pig	38	5
	Guinea pig	39	17
	Bat A. B.	5	15
	Bat A. B.	12	3
Guinea pig 21 (first subinoculation)	Marmoset monkey	58	15
Dog 1 (natural infection)	White mouse	20	16
	White mouse	21	10
	White rat	22	9
	White rat	23	11
	Guinea pig	26	4
	Guinea pig	27	3
White rat 22 (first subinoculation)	Guinea pig	33	14
	Guinea pig	34	15
	Bat A. D.	6	20
Bats (pooled blood from four)	White rat	2	15
Rat 2 (first subinoculation)	White rat	8	14
	Guinea pig	5	8
Guinea pig 5 (second subinoculation)	White mouse	18	14
	White mouse	19	14
	Guinea pig	25	9
Guinea pig 25 (third subinoculation)	Dog 3		19
	Dog 4		10

INCUBATION PERIOD OF TRYPANOSOMA CRUZI IN ANIMALS

The incubation period of *T. cruzi* varied considerably when inoculated into animals. This variation was not due entirely to the strain being changed through numerous transfers since marked differences are shown in the first inoculations. The incubation periods in each animal that became positive from being inoculated with infected blood or were infected through experiments with the *Triatoma geniculata* are shown in table 1.

The same wide variation in the incubation period shown in the animals inoculated with infected blood was also manifested in the guinea pigs inoculated with macerated *Triatoma* (table 2).

It was impossible to definitely determine the incubation periods in the 7 guinea pigs that became infected through feeding the bugs on them since each guinea pig was used as a host for the bugs on from four to six consecutive days. Taking the first and last days on which a pig was used as the maximum and minimum possible time between infection and the appearance of trypanosomes in the peripheral blood, the shortest period was from six to ten days and the longest from eighteen to twenty-two days.

TABLE 2

Incubation period of T. cruzi in guinea pigs inoculated with macerated Triatoma

Guinea Pig Number	Incubation Period (days)	Guinea Pig Number	Incubation Period (days)
40	27	57	7
42	12	59	18
44	7	61	17
45	11	62	22
46	27	63	24
48	9	67	15
49	10	68	23
52	13	71	14
53	10	76	6
55	17	78	13
56	10		

THE DEGREE AND PERSISTENCE OF INFECTION IN VERTEBRATE HOSTS

Our observations on the infection of *T. cruzi* in vertebrate hosts were carried out mainly on the laboratory animals that were experimentally infected during these studies. The majority of the armadillos, opossums, bats, etc., seldom lived more than a few weeks after they were received at the laboratory. Many were killed for intestinal examinations in connection with other investigations that were being carried on at the time. Others died through causes due to previous injuries, improper diet, confinement, etc. The daily handling of them to secure blood for films was also probably inimical to their longevity under laboratory conditions. Furthermore, since the naturally infected animals were positive before they were received there was no way of determining the length of time the infection had persisted before coming under our observation. The small amount of information that we did acquire on the infection in wild animals is given in the previous pages.

The source of the infection in laboratory animals seemed to have but little bearing on the intensity of the infection. There was comparatively little difference to be noted in infections produced through inoculations with positive blood, macerated bugs or by the bugs feeding upon the animals.

Daily blood examinations were made on nearly all the experimentally infected animals during a period of from six to twelve weeks following the appearance of trypanosomes in the blood. After that period the examinations were carried out only at ten-day intervals so long as the animal lived. The thick blood film method was used in these examinations and since the films were made daily by the same person they remained fairly regular with regard to the amount of blood used for each film. These examinations gave a good opportunity for observing the variations occurring in the number of trypanosomes found from day to day, not only between different animals but also the daily changes that took place in individual animals.

The largest number of trypanosomes found in a film during the course of an infection in an animal constituted what we are terming the "peak peripheral infection" and the day on which this peak infection occurred as the "infection peak day." The number of trypanosomes present at the peaks of peripheral infections varied considerably among the animals and ranged from one to more than sixteen hundred. There was also a wide variation shown in the number of days elapsing between the date that trypanosomes were first found in an animal's blood and infection peak day, the shortest time being three days and the longest one hundred and fifteen days.

The 21 guinea pigs that became positive through inoculation with macerated *Triatoma* seemed to be somewhat more consistent in having large numbers of trypanosomes at peak peripheral infections than those in the other experimentally infected groups. One of these guinea pigs ran a very light infection and never showed more than 1 trypanosome to a film and positive films were found only on occasional days. The heaviest infection in this group had more than 600 trypanosomes at the peak peripheral infection. The number of trypanosomes present at the peaks of peripheral infections of the other 19 guinea pigs of this lot when arranged in groups show that two had less than 100 each, three between 100 and 200, two between 200 and 300, eleven between 300 and 400 and two had between 400 and 500 each. Among these guinea pigs there were thirteen that reached their infection peak days in less than twenty days after trypanosomes first appeared in their blood, five in from twenty to thirty days, two in from thirty to forty days and one did not reach the peak until one hundred fifteen days after first becoming positive. This last animal had a comparatively light infection with a peak peripheral infection of 43 trypanosomes.

Two of the guinea pigs that became positive through the bugs feeding upon them never showed more than one trypanosome to a film. The peak peripheral infections of the other five ranged from 150 to more than 300 trypanosomes. These five all reached their infection peak days in from twelve to eighteen days after becoming positive.

The heaviest infection of all the animals was a peak peripheral infection of more than 1600 trypanosomes at twenty-one days after the beginning of the positive infection, which occurred in a guinea pig inoculated with blood from the naturally infected dog 1. The second high peak peripheral infection had more than 1000 trypanosomes after an interval of seventeen days from the first positive day. It was in a guinea pig that was inoculated with blood from human case 1. Among the other animals of this blood inoculated group there were three that showed only one trypanosome to a film. About half of the others had a peak peripheral infection of less than 100 trypanosomes. Taken as a whole this group had a much lower average peak than the guinea pigs infected by means of the *Triatoma*. In this blood inoculated group, which represents rabbits, guinea pigs, white rats, white mice and bats, the guinea pigs ran the heaviest infections.

TABLE 3

Length of infectivity periods in animals and number of animals still infected

Number of Days of Infectivity Periods	Number of Animals	Number of Animals Still Infected
0–25	3	
25–50	6	
50–100	11	2
100–150	15	1
150–200	10	2
200–250	1	
250–300	3	2

One white mouse reached its peak of 78 trypanosomes after one hundred ten days, while another had a peak of 26 trypanosomes after forty-one days. The heaviest infection in a white rat was 303 trypanosomes after thirteen days of infection. The two rabbits reached the respective peaks of 23 and 68 trypanosomes, one in ten days and in the other in thirteen days.

The persistence of infectivity in the 55 experimentally infected animals (exclusive of the 3 bats) varied from one to two hundred seventy-eight and more days, since the animal in which this maximum infection period is still infected at the time of writing. Three of these animals died before the trypanosomes had disappeared from their peripheral blood and three more were sacrificed while still showing the parasites. The periods of infectivity, or the time elapsing between the date of finding the first trypanosomes in the peripheral blood of an animal and the date the last one was noted, have been placed in groups according to the length that the infectivity period of each animal persisted. The number of days in these infectivity periods and also the number of animals that are still showing trypanosomes in their blood streams are shown in table 3.

Various opinions have been given by workers on Chagas' disease in regard to the susceptibility of infection of different animals. There also seems to be a belief that very young animals are much more susceptible than are adults. In our work with this disease we found that guinea pigs proved to be the most satisfactory laboratory animals. All the other laboratory animals that are commonly used were easily infected and most of them ran fairly heavy infections. We found adult animals to be so susceptible to this disease that we had no reason for using very young ones.

PATHOGENICITY OF CHAGAS' DISEASE

Our studies on Chagas' disease have been carried out over too short a period and have been of too superficial a nature to enable us to gain much information of the pathogenicity of *T. cruzi.* None of the 5 human cases, however, appeared to present any very definite symptoms that could be directly ascribed to this disease. The trypanosomes disappeared from the peripheral blood of these 5 cases without specific treatment. If the disease *is* of a chronic nature it may be that the trypanosomes will appear again in the peripheral blood at intervals.

No serious results developed in the animals infected, either naturally or experimentally, that came under our observations. Of the 39 guinea pigs that were experimentally infected there are 33 still living. The length of time that has elapsed since finding the first trypanosomes in the blood of each of these 33 guinea pigs and the date of this writing varies from sixty-six to two hundred seventy-eight days. Only two have periods of between sixty-six and one hundred days, one has one hundred thirty-three days, thirteen have between one hundred fifty and two hundred days, fourteen between two hundred and two hundred fifty days and there are three between two hundred seventy and two hundred eighty days. The guinea pigs showing the two highest peak peripheral infections of 1600 and 1000 trypanosomes are still alive after the respective periods of two hundred six and two hundred seventy-eight days. The one with the 1000 peak is still showing trypanosomes. The other one with the 1600 peak has been giving negative films during the past seventy-two days. Of the two rabbits inoculated one is still alive two hundred seventy-nine days after its first infected day. One white rat out of six that were infected is still living after two hundred seventy-seven days; one of the other five was sacrificed. It would appear that a much larger percentage of these animals should have died before this date if the trypanosome possessed a high degree of virulence.

Examinations of sections of heart muscle from an armadillo, a dog and an opossum revealed the presence of leishmania forms of this trypanosome but extended searches were necessary to locate them. These animals had all shown the trypanosomes in their blood. Many animals with positive blood films have failed to show leishmania forms in the heart muscles. Perhaps the infection is completely eradicated in many cases. The heart muscle is not invaded in the striking manner that is noted in sarcosporidiosis. This form of trypanosomiasis seems to belong to animals that live in dens or burrows rather than to other animal species or to man.

The region in which the human cases were found had been recently cleared and placed under cultivation. As a result nearly all burrowing animals had been killed for food or to prevent destruction of crops. This, no doubt, left the insect vector without its normal host for blood meals and forced it to meet compulsory conditions which meant feeding on other animals. The human being is probably not the host of choice.

SUMMARY

1. Five cases of Chagas' disease have been found in children in Panama during the past ten months.

2. Rabbits, guinea pigs and white rats were inoculated and became positive with heavy infections from one of these human cases. This strain was successfully transferred to a monkey, guinea pigs, white rats, white mice and bats.

3. A young dog naturally infected with trypanosomes that appear to be identical with those found in the human cases was discovered at the home of the first human case.

4. Guinea pigs, white rats and white mice were infected through inoculation of blood from a naturally infected dog. This strain was carried on to other guinea pigs and a bat.

5. Twenty-eight armadillos, *Dasypus novemcinctus fenestratus* Peters were examined and six, or 21.4 per cent, were found to be infected with a trypanosome that we believe to be *T. cruzi*.

6. Eighty-one opossums, *Didelphis marsupialis etensis* Allen, were examined and twenty or 24.6 per cent were found infected with what was apparently *T. cruzi*.

7. A squirrel, kept as a pet in the house where two cases of Chagas' disease lived proved to be infected with a trypanosome identical with *T. cruzi*. This was the second occasion in which a pet, in the same household with one of the five human cases, was found positive for trypanosomes.

8. Bats infected with a trypanosome believed to be *T. cruzi* were found in Panama. A total of 161 of these flying mammals was examined and 30, or 18.6 per cent proved to be infected. Those found positive represented 5 species.

9. The trypanosome of the bats was readily transmitted to dogs, guinea pigs, white rats and white mice.

10. Ninety specimens of *Triatoma geniculata* were collected in the Chilibrillo Caves. This completes a record of infected Triatoma, infected bats and an infected opossum found in the same chamber of these caves.

11. The feces of 55.5 per cent of the bugs proved to contain trypanosomes.

12. Twenty-six guinea pigs were each inoculated with a macerated *Triatoma* and 21, or 80.8 per cent, became positive.

13. Seven guinea pigs became infected through *Triatoma geniculata* feeding upon them. It was not determined whether these infections were caused through the bites of the bugs or through infection with their feces.

14. The incubation period of the experimentally infected animals varied from three to twenty-eight days.

15. The degree of the infection in the experimentally infected animals varied considerably. One guinea pig had a peak peripheral infection of more than 1600 trypanosomes in a thick blood film.

16. The persistence of infectivity has extended in 1 guinea pig for more than two hundred and seventy-eight days.

17. Although all our laboratory animals could be infected with this trypanosome the guinea pig seemed to be the most satisfactory for experimental purposes. The adult animals proved so susceptible to infection that no very young ones were used.

18. The trypanosomes soon disappear from the peripheral blood of the human cases. Infected animals have lived for a considerable number of days since the beginning of their infection and in some of them trypanosomes have been found for many days.

19. Leishmania forms of the trypanosome have been found in the hearts of some animals but others fail to show them.

20. Our experience indicates that this trypanosome does not possess a high degree of virulence. However, we cannot read what the future holds in store in the way of remote serious sequelae.*

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ONCHOCERCIASIS IN GUATEMALA

Preliminary Report

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In Guatemala, in certain areas on the Pacific slopes of the volcanic ranges, one encounters, with great frequency, a subcutaneous tumor or fibrous nodule which is usually situated upon the head and is of parasitic origin. Attention was particularly attracted to this condition by Robles in 1915; and, in 1919, he published an account of the condition, and showed that it was caused by a species of filaria. He also emphasized that the fibromatous nodules upon the scalp were often associated with disturbances of the eyes, particularly of vision; and that these disturbances disappeared following removal of the tumors. He believed, in addition, that the parasite produced a definite type of erysipelas which was termed *Erisepela de la Costa.* Subsequently, Luna, Calderon, Azurdia, and others confirmed these investigations of Robles; and verified the favorable results obtained by the removal of the tumors and the relief thereby of the eye symptoms.

Brumpt, who studied pathological material furnished by Robles, described the filaria found in the tumors as a new species. While it is almost identical with the species *Onchocerca volvulus,* found in subcutaneous fibromata in Africa; Brumpt reported that it differed especially in the size and distribution of the papillae in the male parasite, and by the great size of the spicules. Also, on account of the differences in location in general of the tumors in patients in Africa and Guatemala, he separated it as a new species, calling it *Onchocerca caecutiens,* or the blinding onchocerca.

In 1924, the Medical Department of the United Fruit Company gave opportunities for further study of this disease, through the International Conference on Health Problems; which it held in Kingston, Jamaica. At this conference, Professor Fülleborn presented a most important contribution to our knowledge, at that time, of the "Blinding Filaria of Guatemala." Fülleborn made a visit to one of the Guatemala plantations, where about 70% of the natives were infected. However, he was not able to confirm the connection between the presence of the parasite and the disturbances in the eyes. Nevertheless, he was very guarded in his statement regarding this question; and expressed himself as far from doubting the experience of colleagues who had a much wider experience in the study of the condition. Professor Castellani, who also observed this condition in Guatemala about the same time, expressed the opinion that the eye symptoms and certain pathological changes in the skin indicated that coastal erysipelas was associated with the nodules and the onchocerca.

At this period, no histological studies had been made of the lesions of the eyes; and the writer shortly afterwards made plans for such studies, as well as for the study of the method of transmission of the infection. However, these investigations had to be postponed until after the work of the Harvard African expedition was completed.

In 1926, Blacklock, working in Sierra Leone, demonstrated by detailed investigations that the black fly, *Simulium damnosum*, was apparently the insect which transmits the infection with *Onchocerca volvulus* in Africa.

In 1926, the writer, with Drs. Bequaert and Shattuck, had the opportunity to study African Onchocerciasis in Liberia and the Belgian Congo, and to confirm the discovery of Blacklock with reference to transmission.

During the past year, through cooperation with the United Fruit Company, it has been possible to carry on, in Guatemala, a more complete and careful study of onchocerciasis; and, at the present time, we are in a position to make a preliminary report describing further advances of our knowledge of the disease.

While investigations were being made upon the condition in Guatemala; attention was also attracted to its occurrence in parts of southwestern Mexico, and particularly in the states of Oaxaca and Chiapas. Laurembee and Hardwicke reported upon the occurrence of blinding sickness in Oaxaca, with ocular symptoms which were relieved by incision and evacuation of the cyst contents containing the onchocerca; while, in Chiapas, Hoffmann and Ochoterena have also issued important and valuable publications in regard to the condition in Mexico.

It is of some interest to compare the condition which we observed in Guatemala with that which we encountered in Africa. Infection with *Onchocerca volvulus* is very common in parts of Africa, particularly in the central and western portions. In some localities, 10%, and in others as many as 50%, of the natives are affected. The tumors usually measure from one to six centimeters in diameter; and are commonly found in the chest wall (particularly in the lateral regions) and the intercostal spaces, and occasionally on the dorsum. They occur also in the neighborhood of the joints and in the axilla. As a rule, after removal they are firm and greyish-white in the periphery; but there are often soft areas in the more central portions, and especially in those areas which have a yellowish or orange color. It is in these soft areas or cavities that the adult filarial parasites are usually found, together with enormous numbers of the microfilariae. The tumor is frequently surrounded by a capsule. Histological examinations of the different tumors collected in various localities in Africa show that they are all fibromatous in nature. In the center, sections of the adult parasites are commonly found, usually imbedded in the connective tissue stroma. Immediately about the parasites there is often some evidence of irritation caused by the parasite itself. A few polymorphonuclear leukocytes are scattered about with small round cells, occasionally plasma cells and eosinophils. Outside of these areas, the tumor is composed largely of fibrous connective tissue. Here, the fibroblasts are few in number; and the fibroglia fibrils are not abundant. The tumor is composed mainly of collagen fibers, forming wavy bundles. In none of the tumors does the cells show marked evidence of mitotic division, nor are numerous giant cells present; so there is no evidence that the neoplasms are formed very rapidly. However, Hoeppli, who studied one onchocercal tumor histologically, found numerous giant cells; and in several places the microscopical picture resembled that of a giant cell sarcoma. Shafti Mohammed, who examined histologically two onchocercal tumors—one associated with *Onchocerca volvulus* and one with *Onchocerca gibsoni*—found, especially in the volvulus tumor, that the tunnel walls and the stroma between them were made up of either purely cellular tissue, the cells being mainly endothelioid, or of immature fibrous tissue; or else of adult fibrous tissue with fewer cells, these being mainly adult connective tissue cells. He believed the cellular areas in the stroma were the result of a reaction against the concentrated toxins locally of the worms and embryos. He points out that this cellular tissue later becomes fibrocellular and, ultimately, adult fibrous tissue.

There seems to be no doubt but that the parasite is the inciting factor in the formation of the neoplasms. However, as is usually the case with other parasites, in not all of the individuals infected with *Onchocerca volvulus* in Africa are tumors present. Blacklock found, for example, that in sixty-eight individuals who had *Onchocerca volvulus* larvae in the skin, only 40% had visible subcutaneous nodules. Sharp believes that the first stage of the disease is not a subcutaneous tumor but the existence of active embryos in and around the corium; and he thinks that the tumors are only late manifestations of the infection. In Nigeria he found skin infection in 55%, but tumors only in 30%. The African onchocercal tumors usually cause little inconvenience to the individual, and ocular disturbances have not been observed.

While the nodular tumors of *Onchocerca volvulus* in Africa are situated almost invariably upon the trunk or extremities; in Guatemala, those produced by *Onchocerca caecutiens* occur, with few exceptions, upon the head, and usually in the region of the scalp. The tumors in Guatemala are, as a rule, somewhat smaller than those which we observed in Africa, many not measuring over six to twenty millimeters in diameter. They, in this respect, resemble rather the nodules caused by *Onchocerca gibsoni* in cattle in Australia. The tendency to the production of keloid growths, among many Africans subject to *Onchocerca* tumors, is very common; and such growths may follow almost any form of injury or irritant applied to the skin. The writer thought that perhaps this tendency to abnormal reproduction of connective tissue following mechanical irritation might sometimes be an additional factor in the production of the larger *Onchocerca* fibromata, which occasionally reached considerable dimensions. However, in Guatemala, the classes of individuals among whom infection occurs with *Onchocerca caecutiens* do not show any tendency to keloid formation as is so commonly the case in Africa. Moreover, in some instances, *Onchocerca* tumors were observed in Guatemala which measured at least five centimeters in their greatest diameter or length.

The Guatemalan tumors are also enclosed in a fibrous capsule; and contain, in the central portions, the adult male and female filarial parasites and numerous microfilariae. In some cases, the tumors are lentil-shaped; and lie in shallow depressions on the surface of the skull, the periosteum being either adherent to or fused with the inferior surface of the cyst wall. In other instances, the periosteum has apparently become absorbed. In one instance, a small tumor about 3 mm. in diameter was found in a shallow cavity in the cranium, which was about 3 to 4 mm. in diameter and 2 to 3 mm. in depth, the bone being exposed. The Guatemalan tumors, like the African ones, are fibromatous; and none of them shows any malignancy.

Among adults who gave a history of the existence of tumors (due to *Onchocerca caecutiens*) for five years or longer, poorness of vision was frequently complained of; and a number were almost blind. Some of the advanced cases suffer with photophobia; and show pericorneal infiltration of the conjunctivae, with extensive keratitis and iritis. The iritis is usually secondary to the changes in the cornea. The lesions which occur in the eyes as a result of the filarial infection are apparently chronic in character. The microscopic examinations made recently by the writer, of sections of eyes removed at autopsy and at operation, suggest that the lesions of the eye are at least partly due to the continued passage of large numbers of microfilariae through the lymphatic vessels or lymph-spaces of the eye, and to the dilatation and oedematous condition and perivascular infiltration which result. The adult parasites are not found in the eye. The microfilariae of *Onchocerca caecutiens* evidently seek the light and, hence, especially the tissues of the eye. We have found them in individuals with poor vision, in sections of the pericorneal conjunctiva, cornea and iris (obtained at operation); and in greater numbers than in the skin. Whether some of the disturbances of the eyes are due to a toxin produced by the parasite, is not clear.

We have also investigated the blood and serum in the disease. Eosinophilia is present; and counts of eosinophiles of from 25 to 50 per cent. are usual. The serum of several of the cases of long standing gave a precipitin reaction, with an aqueous or alcoholic extract of the tumors employed as antigen. Subsequent detailed experiments have shown that this reaction is certainly usually entirely negative. Also, a rabbit serum, prepared by repeated intravenous inoculation of the animal with an extract of the tumors, gave no such reaction.

In the clinical studies, 1,383 individuals have been examined; and the tumors were removed in 261 cases. Some of the tumors have been hardened in Zenker's solution for histological study; while others have been used for the preparation of antigen for serum reactions, and still others for the isolation of the adult parasites.

The adult parasites, both male and female, have been separated from the tumors and obtained entire—particularly by digesting the nodules in different ways; and especially with fresh papaya juice, or with papaine in 0.2% hydrochloric acid, or by the introduction of the tumors into the stomach of different animals. The *male* parasites commonly measure from 2.5 to 3 mm., and the females from 30 to 44 cm., in length. We prefer to refrain from discussing the relationship of *Onchocerca volvulus* Leuckart (1893) to *O. caecutiens* Brumpt (1919) until all our *O. caecutiens* material has been compared with that relating to *O. volvulus.* The developmental forms of *O. caecutiens,* as observed by us in *Eusimulium,* are on the whole of greater dimensions than those that have been observed in the case of *O. volvulus* in *E. damnosum.*

The microfilariae of *Onchocerca caecutiens* which are found present in the sections of the epidermis or conjunctiva, are actively motile; and measure from 150 to 250 μ (rarely from 285 to 300 μ) in length, and from 6 to 7 μ in width. They are not found naturally in the blood. When, as might rarely happen, one has been seen in a preparation of the blood; it has evidently come from a lymphatic vessel punctured in obtaining the specimen. If a thin section of the epidermis of the face or neck of an infected individual is made (preferably with a safety razor blade), without causing any flow of blood, and is examined fresh in a drop of normal saline solution; one or two and up to four to eight motile microfilariae, are usually found, and occasionally as many as fifty are observed.

Doctor Bequaert and the writer, working in Guatemala, have been able to demonstrate that three species of *Eusimulium* flies are concerned in the transmission of the disease (*Eusimulium avidum*, *Eusimulium ochraceum*, and *Eusinulium mooseri*).

When a *Eusimulium* of these species is allowed to engorge itself (which usually requires from 3 to 5 minutes) upon a suitable infected individual; the microfilariae, from some dozen up to several hundred, are found practically always in the gut of the fly shortly after it has fed. The microfilariae in the gut, which are not digested or otherwise killed, pass from the gut shortly afterwards to other parts of the fly; and particularly to other parts of the abdomen and to the thoracic muscles, where they may be found in the tissues in numbers from one or two to several hundred, from 24 to 48 hours after the infective meal of the fly. The microfilariae observed in the abdomen of the fly are actively motile, and exhibit frequently more marked activity than they do in the sections of the skin. They measure usually from 200 to 300μ in length and from 5 to 8μ in breadth. The conditions which the microfilariae find in the thoracic muscles evidently cause marked changes in their development. At first, they usually increase slightly in length. However, within a few days, probably varying somewhat according to temperature, they become very much broader, from 22 to 25 μ in breadth or even wider, but without corresponding or great increase in length. Indeed, some of the forms appear shorter. At this stage, the broader forms show very decided changes in the caudal appendage; which is no longer tapering, but has become transformed into a short, pointed tail. Definite indications of the development of the alimentary tract are also visible, which has become developed into two distinct sections following a rudimentary esophagus. Two caudal papillae can also be distinguished in some. These forms (which correspond roughly to those that have been described in the development of *Filaria bancrofti* in the mosquito as torpedo or sausage forms) measure most usually, when extruded from or found in the thoracic muscles of *Eusimulium*, from 200 to 555 μ in length and from 22 to 45 μ in width. A single one measured only 165 μ by 15 μ. Another striking change from the microfilarial stage noted in these thoracic forms, is in their movements. They no longer squirm about; and do not as a rule exhibit marked active motility, nor do they progress suddenly from place to place. Instead, they bend gently and slowly at various parts of the body. They sometimes seem to slip or glide out of the thoracic muscles; particularly when the dissection of the fly is made in normal saline solution.

In the course of several days, another striking change is noted in the further development of these broader types; which gradually become longer and more slender, and more filarial in type. These more advanced forms are encountered in the thoracic muscles, in the head and proboscis, and sometimes in the upper portion of the abdomen; particularly about and closely applied to or within the Malpighian tubes. They are endowed with very active movements and with considerable strength of movement, as is indicated by the way they move the tissues about with which they come in contact. Such forms measure from 450 to 1140 μ in length and usually from 16 to 25 μ in breadth. Only two forms measured as much as 30 μ in their greatest breadth. The alimentary canal of these forms has become much more developed, and may be seen to extend from the anterior end to the narrow slit-like anus on the side near the tip of the tail. The caudal papillae, which become first visible in the broader forms, also show further development; and the rudimentary indications of the genital and nervous systems are visible in some of the more advanced forms. Noteworthy anatomical differentiation of the developmental forms can particularly be distinguished by the staining reactions of the preserved specimens, which were first hardened in hot 70% alcohol and later stained in Giemsa solution or haematoxylin. These will be fully described and illustrated in the complete report of the work in Guatemala.

We have encountered in our studies of *Onchocerca caecutiens* in *Eusimulium* in Guatemala, forms which we did not encounter in the study of *O. volvulus* in *E. damnosum* in Africa in 1926 and which have not previously been described. However, in Liberia we did not have the extensive material to work with that we have had in Guatemala. Blacklock, who first described the development of *O. volvulus* in *E. damnosum* in Africa, in 1925 and 1926, has published in full detail the development of this African parasite; and gives the measurements of the most advanced filarial forms in casual flies as 560 to 660 μ in length and 18 to 28 μ in breadth, and in flies which had fed upon a known infected case as 349 to 628 μ in length and 20 to 38 μ in width. In his second communication on the subject he mentions the longest form which he obtained as attaining the length of over 760 μ.

In the dissection and microscopical examination of 2,088 *Eusimulium* flies caught in Guatemala, 233 or some 11% have been found to harbor some form of *Onchocerca caecutiens*. However, in 430 cases the flies were taken for study while feeding upon individuals known to have onchocercal tumors. Of 1,658 simuliid flies that were captured at random about the villages, 89, or about 5%, were found infected with the parasite. All stages of development of *O. caecutiens* have been repeatedly observed in *Eusimulium*, from the time of the ingestion of the microfilariae from the skin of the infected individual up to the fully developed infective filarial form in the thoracic muscles, head and proboscis.

We have been fortunate in securing permanent specimens of the infective filarial form passing through and emerging from the labium of the proboscis. In this study, 4,572 flies have been dissected and examined microscopically. Other insects, and particularly culicine mosquitoes, are not concerned with the transmission of the disease.

The mosquito has a considerably longer proboscis than the Eusimulium fly, and evidently inserts the proboscis deeply in sucking blood. The microfilariae of *Onchocerca*, which are not encountered naturally in the blood but are found in the lymphatics of the skin, are not even ingested by the mosquito when it is fed on infected individuals. Possibly, also, the saliva of the mosquito repels the microfilariae of *Onchocerca caecutiens*.

The conditions under which onchocerciasis occurs in Guatemala are widely different from those under which it prevails in Africa. Recent investigations in Guatemala indicate that conditions there are such that, by the inauguration of a proper public health campaign, the disease might be eradicated entirely. The affection in Guatemala is confined to rather sharply circumscribed areas, especially about coffee plantations with an altitude of from 600 to 1400 meters. In such localities, from one-third to two-thirds of the inhabitants are affected with onchocercal tumors. Certain public health procedures are of importance, and must be carefully carried out for the eradication of this disease. As the breeding-places of the *Eusimulium* concerned in its transmission are so widely distributed in practically every swiftly flowing stream of water in the neighborhood, the complete eradication of these flies in such coffee districts is probably impracticable. However, the recent work of O'Kane, in the eradication of black flies from mountain streams through the introduction of Phenotas oil, would appear to be of some use in the elimination of these flies.

Every severely infected case constitutes a focus of infection. Many individuals are so badly infected that every *Eusimulium* fly which bites them is likely to ingest a hundred or more microfilariae; while, in a mildly infected case, a fly may not take up more than one or two microfilariae. Public health procedures should include inspection of the inhabitants in the endemic districts and the diagnosis of the cases with filarial tumors, with prompt removal of the fibroid growths and the adult male and female parasites within them. The operations are simple, and easily performed under local novocain anesthesia. However, the microfilariae do not always disappear immediately following the operation; but sometimes persist for a considerable time thereafter.

In order to rid the patient of the microfilariae which may persist after the removal of the tumors, experiments were performed to discover a satisfactory filaricidal substance. It was found that in vitro plasmoquin, in dilutions up to 1 to 10,000, effectively destroys the microfilariae. Quinine, in a dilution of 1 to 5,000, also produces somewhat similar results. The results obtained with these substances were so encouraging that they give hope for the destruction of the microfilariae in the tissues of man, if prolonged treatment with sufficiently large doses can be employed. It is not at all likely that the adult parasites, so well protected by their structure and located in the center of the tumors, will be destroyed or even unfavorably influenced by such treatment; but plasmoquin is certainly inimicable to the existence of the microfilariae and, in a few instances, they have at least temporarily disappeared from the skin following a short course of treatment with relatively small doses of this drug.* However, about a month after discontinuing the plasmoquin, in several such cases microfilariae were again found in the skin; suggesting either that they had not been entirely destroyed or, what is perhaps even more probable, that these patients still harbored adult parasites that were producing additional larvae. In cases in which, after removal of the tumors (together with the adults contained in them), the microfilariae persist in the skin and do not disappear under treatment with plasmoquin; a careful search should be made for small nodules beneath the skin. In some such instances, with persistence of the microfilariae, it is clear that adult parasites may still be present, concealed somewhere in the lymphatics, giving rise to large numbers of new larvae. While in Guatemala we found few individuals with *Microfilaria caecutiens* in the skin with no visible tumors, nevertheless such cases were observed in at least 4 to 5 per cent. of the inhabitants examined. This condition is again different from what is found in Africa, where the percentage of infection with *Onchocerca volvulus* with no visible tumors is very much higher. In Guatemala, periodic microscopic examinations should be made in each individual after operation, to detect the number of microfilariae which still persist. If large numbers of microfilariae are still present; the patient should be regarded as a dangerous carrier, and be isolated until the parasites diminish or disappear through treatment.

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* Torello recently published an article in which the value of plasmochin in onchocerciasis is confirmed and ocular cases are reported as successfully treated by injections.

The expedition to Guatemala, during which the work recorded in this article was performed, consisted of Dr. Joseph C. Bequaert, Assistant Professor of Entomology at the Department of Tropical Medicine of Harvard University, Dr. Miguel Munoz Ochoa, Chief of the Parasitological Division of the Department of Public Health of Guatemala, and Mr. B. Bennett, a Technician of the Department of Tropical Medicine; besides the writer. The entomological side of the work will be fully described by Dr. Bequaert in the complete report, which will also contain the epidemiological data by Dr. Ochoa. Acknowledgments of assistance and courtesy, as well as fuller references to the literature, will likewise be given in the final report.

At the present time we wish to express our indebtedness to Mr. Victor M. Cutter, President of the United Fruit Company, for his interest and support in these investigations; and to the late Dr. W. E. Deeks, who was already ill, for his sympathetic interest. We are also very appreciative of the cooperation of Dr. R. C. Connor, General Manager of the Medical Department, who made the preliminary arrangements for the carrying on of the investigations. In Guatemala we are particularly indebted to Dr. N. P. Macphail, Medical Superintendent at Quirigua, for many introductions and much advice regarding the prosecution of the work. We are also much indebted to Mr. J. H. Wilson, to Mr. E. J. Lagarde, Division Freight and Passenger Agent of the United Fruit Company, and to Mr. C. F. Myers, President of the International Railways, for many courtesies in connection with our investigation in Guatemala. We are likewise very grateful to Mr. D. S. Hodgson, for allowing us to prosecute our studies on his coffee plantation at El Pacayal. To Mr. Gordon P. Smith, we are very greatly indebted for allowing us to work on his plantations at Moca, and for providing us with all practicable facilities for the prosecution of our studies and assisting us in innumerable ways. Without his help, some of our work could not have been performed. We are also deeply indebted to the officials of the Health Department of Guatemala, for many courtesies. Dr. Calderon, who has written a most interesting and important monograph upon the disease, very kindly visited us at Moca and discussed with us his earlier studies.

Other acknowledgments to Guatemalan physicians will be made in the complete report.

TYPHOID FEVER IN BANES, CUBA

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Last year we submitted a report on the typhoid fever situation in Banes, which appeared in the Nineteenth Annual Report of the Medical Department. We discussed therein the endemic existing in Banes, and the fifty-one cases of the disease admitted to the Company's Hospital for treatment during the year 1930. We are now adding a few notes on forty-two cases admitted during the year 1931, to serve as a comparison with the cases admitted in 1930 and to complete the report for that year.

Anti-typhoid Vaccination.—Considering that typhoid fever is a carrier disease; that the number of carriers in the area must be very large; and that it is practically impossible to exercise any kind of effective control at present over these carriers of bacilli, or over the water, milk and other food supplies, or over the fly menace; it would seem that our only hope of obtaining some measure of control would be the immunization of as many individuals as possible by means of antityphoid vaccine. This has been attempted for a number of years, but with very meager results. One reason therefor would seem to be the impracticability of the method requiring three injections, at weekly intervals, to complete immunization. While utilizing that method, it was found that a large percentage of the persons who received the first injection were never given the second or third dose as it was difficult or impossible to find them; and, in many cases the second or third inoculation was not given at the proper interval, because the person would not appear until several days after the injection was due. In view of these difficulties, it was thought advisable to use the single inoculation; and, instead of giving half a cubic centimeter as a first dose and one cubic centimeter as a second and third dose at weekly intervals, to give two and a half centimeters at one time to a normal adult and to modify the dosage for children and frail individuals. Under existing conditions, it is expected that better general results will be obtained by using this method; although it is still an open question whether the single dose of high concentration is as effective as the three injections at weekly intervals. However, the results of agglutination tests in persons so vaccinated would seem to indicate an effective immunization. (See article entitled "Antityphoid Vaccination," in this Report.) During 1931, a total of 8,120 single dose inoculations were administered; and the work is continuing apace. These are divided into 4,147 inoculations in the Banes urban area, 1,602 in Macabi (where the sugar mill is located), and 2,371 in the outlying countryside.

Vaccinated Cases of Typhoid Fever.—Five of the forty-two cases here reported gave some history of previous vaccination.

1. Hosp. Case #2279 was given the first dose of vaccine about one month before the beginning of his illness; but did not get the other two injections because he was always away from home when the vaccinator called.
2. Hosp. Case #2177 stated vaguely that she had had "six" injections against typhoid fever; but did not recall the dates of inoculation, and could not give any definite information.
3. Hosp. Case #2613 was given the three injections about three months before the onset of the illness.
4. Hosp. Case #2799 was given the single injection of high concentration September 23rd; became ill October 28th; and was ill twenty-three days.

5. Hosp. Case #2893 was vaccinated with the single injection of high concentration on July 1st; became ill November 7th; and was ill twenty-three days.

These last two cases were able to show their vaccination certificates; so that there is no question as to the vaccinations. The other three cases may be disregarded; but we have two cases out of forty-two with a definite history of recent vaccination.

Distribution of Cases by Locality.—Upon comparing the localities from which the cases were admitted this year with those of last year; we find that the La Güira section had nine cases this year and seventeen last year, and Banes town had four cases this year and fifteen last year. Macabi, which had only one case last year, had ten cases this year; and most of them came from two neighboring families. The remaining cases (18 in 1930, and 19 in 1931) came from isolated camps; and not more than one or two were from any individual camp. This strengthens the impression that we are dealing with a carrier-contact endemic.

TABLE I

Localities

	1930		1931	
Banes Local Town	15		3	
Company Town	—		1	
La Güira	17	32	9	13
Macabi		1		10
District I	6		1	
District II	2		5	
District III	4		10	
District IV	6	18	3	19
		51		42

Date of Admission.—The record of admissions by months during 1931 shows that the largest number of cases occurred in the months of March and June—seven and eight cases respectively. In the four months period from March to June inclusive, twenty of the forty-two cases, or 47.61%, were admitted. This corresponds with the data for 1930; when twenty-seven of the fifty-one cases, or 52.94%, occurred in this four months period.

Age Groups.—Of the forty-two cases, eighteen (42.85%) occurred in children up to fourteen years of age, and twenty-four (57.14%) in the other age groups. This coincides with the findings in 1930, when 45% and 55% occurred in the respective groups.

Sex Groups.—There were twenty-two males and twenty females treated, as compared with thirty-six males and fifteen females in 1930.

CLINICAL DATA

Duration of Disease.—This correlated closely with the figures for 1930. There was one case who was ill only thirteen days; and one case in which the fever remitted definitely on the sixty-sixth day.

TABLE II

Duration of Diseases

	Days						
	0–19	20–29	30–39	40–49	50–59	60–69	
1930	15	15	15	1	3	2	51 cases.
	29.40%	29.40%	29.40%	1.96%	5.88%	3.92%	
1931	10	15	10	2	3	2	42 cases.
	23.80%	35.71%	23.80%	4.76%	7.14%	4.76%	

Blood Examinations (*Widal Reaction*).—Thirty-eight of the forty-two cases gave a frankly positive Widal reaction, in a dilution of 1:100. The other four cases, although the Widal was negative, were, clinically, cases of typhoid fever; and were so diagnosed:

1. Hosp. Case #1670.—Widal was negative on the day following admission. Widal and culture were negative three days later. Widal was negative on the seventeenth day of the disease. Leucocyte count was 11,000. Urine was negative.
2. Hosp. Case #1863.—Widal was negative on admission and three days later; negative for para-typhoid A. and B.; leucocyte count, 16,500; urine, negative. This patient had been caring for his mother, who had typhoid fever and was in the Hospital at the time. He had typical rose spots. Duration of illness was twenty-one days.
3. Hosp. Case #2318.—Widal was negative two days after admission. Widal and culture were negative on the nineteenth day; also negative for paratyphoid A. and B. Leucocyte count was 6,750 on admission, and 3,750 four days later. Urine showed albumin on admission, but was afterwards negative. Duration of illness was nineteen days. The spleen was palpable.
4. Hosp. Case #2704.—Widal was doubtful on admission, which was the eleventh day of the disease. The mother of this patient had died of typhoid fever one week before he was taken ill. One brother had had typhoid four months before. One sister, with positive Widal, was admitted at the same time.

Complications.—One case of special interest was noted. An eighteen-year-old, Cuban female was admitted with a history of high fever for the preceding week, and intense weakness and anemia. Since the age of two years, she had been passing fragments of Taenia of undetermined type. In spite of repeated treatments, when she would expel "yards" of the worm, she was never definitely cured; and her mother stated that she continued expelling pieces of the worm up to her fourteenth year. She was always very anemic, suggesting Bothriocephalus latus anemia. One month prior to hospital admission, she began to complain of giddiness; and, on several occasions, fell on the floor. A local physician had treated her for "intestinal parasites." One week before admission, she began to have fever; and it had grown gradually worse until she was brought to the Hospital with a temperature of 104°F. The examination revealed a young, adult female; who was well nourished and not emaciated, but evidently acutely ill. The conjunctivae and mucous surfaces were intensely pale, denoting a profound anemia. The tongue was coated. A hemic murmur was heard over the heart. The liver and spleen were not palpable. Repeated laboratory examinations revealed a negative urine. The stools were negative; R. B. C., 1,095,000;

leucocyte count, 6,500; differential count: lymphocytes 40%, large mononuclears 5%, staff 5%, polynuclear 48%, eosinophiles 1%, basophilic myelocyte 1%; hemoglobin, 30%; megaloblasts, 82%, and normoblasts, 18%; polychromatophilia; basophilia; anisocytosis; Howell-Jolly bodies. These findings indicated a pernicious type of anemia, of undetermined origin. Widal reaction was positive, in a dilution of 1:100. The patient had signs of mental disturbance when admitted; her high temperature remained unabated; and death occurred six days following admission.

Other cases showed the usual complications. Definite enterorrhagia occurred in two cases. Acute bronchitis, acute nephritis, palpable spleen, and palpable liver were observed in an average number of cases. Two of the cases that died developed broncho-pneumonia. Three cases presented acute suppurative adenitis. One had urinary retention. One case that died had a panophthalmitis. Six cases had Ascaris lumbricoides. Nine cases showed symptoms of marked nervous irritability, delirium, severe coma, etc. One developed the disease while in the puerperium, within ten days of child birth.

DEATHS

There were four deaths in the forty-two cases, or 9.52%. In 1930, we had five deaths in fifty-one cases, or 9.80%:

> Case 1.—Hosp. Case #2712. This case has already been commented upon, under complications.
>
> Case 2.—Hosp. Case #2296. A Cuban, female child, six years of age, had been ill at home fourteen days before admission; and was admitted with definite signs of intestinal hemorrhage, broncho-pneumonia, acute nephritis, and marked mental hebetude. She died seventy-five hours after admission. The Widal was positive.
>
> Case 3.—Hosp. Case #2422. A Cuban, male adult, had been ill at home seven days before admission. His condition, on admission, was fair. Seven days later he developed signs of broncho-pneumonia; and death occurred six days later. The Widal was positive.
>
> Case 4.—Hosp. Case #2677. A Cuban, adult female had been ill at home twenty five days before admission. This patient had been taking care of a son, who was ill with typhoid fever, one month before the beginning of her illness. At that time, she had refused vaccination. She had declined to come to the Hospital until she was very ill. Upon admission, her condition was critical; and she had severe mental symptoms. This case developed an acute inflammatory condition, involving the whole left eye. She died six days after admission. The Widal was positive.

CONCLUSIONS

1. Typhoid fever is endemic in Banes, Cuba.
2. The three injection method of anti-typhoid vaccination is not practical, when dealing with a civil population of the character herein described.
3. It is expected that the use of a single dose of vaccine, of higher concentration, will be a more efficient means of immunizing the population.
4. Typhoid fever will develop in a certain number of cases, in spite of vaccination to immunize them.

ANTITYPHOID VACCINATION

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In prophylactic vaccination against typhoid fever, the method of administration of the vaccine usually recommended is to give three doses subcutaneously at intervals of about one week—the dosage for adults being 500 millions killed bacilli for the first dose, and one billion (1,000,000,000) each for the second and third doses. In actual practice, when dealing with a civil population in a large area, where a large percentage of the people are poor and ignorant persons who are more or less recalcitrant to such procedures because of their inability to understand the advantages to be derived therefrom; it has been found very difficult, if not impossible, to immunize a large percentage of them. The reason for this is that, whereas a given number will get the first dose of vaccine, only a small proportion of these will be found when the second and third doses are to be administered. Such people will not come, of their own volition, to be vaccinated. It is necessary to visit their houses, one by one; and even after repeated visits it is sometimes impossible to get all the dwellers of a home—or, what more often happens, even though they get the first dose of vaccine, the subsequent doses have to be given after a longer period has elapsed than is convenient; so that effective immunization is not obtained. For these reasons, it was thought advisable to consider giving a single vaccination dose which, if effective, would achieve immunization of those injected.

According to Dr. Tomás R. Yanes, Medical Officer of the Cuban Army (cit. #1), the procedure of administering a single vaccination dose has been in use in the Argentine Army since 1919. They had made the observation that the method used in 1916, of giving three doses with weak concentrations of bacilli (100,000,000, 300,000,000, and 500,000,000 at each respective dose) was not as effective as desired. They then increased their dosage; and in 1918 used 500,000,000 bacilli for the first dose, 1,000,000,000 for the second dose and 1,500,000,000 for the third dose; which proved more efficient. The same year they used, also, in another group, a two dose method of giving 2,500,000,000 and 5,000,000-,000 bacilli respectively; and, finding that such high dosage was innocuous, decided in the following year to use a single inoculation of high concentration, giving 5,000,000,000 bacilli in one cubic centimeter at one dose. Only in exceptional cases did the reactions from such high dosages seem to be more severe than when a lower dosage was used; and, even in such cases, the high dosage was well tolerated. They have been using this method ever since; and their typhoid rate has been consistently lower each year. Considering the good results obtained by the Argentine Army, the Cuban Army authorities decided to use the

the same "single high concentration dose;" and they report better results than were obtained when the three dose method was used. The vaccine that they use (similar to that used by the Argentine Army), consists of 4,000,000,000 typhoid bacilli, 500,000,000 paratyphoid A, and 500,000,000 paratyphoid B; or a total of 5,000,000,000 bacilli, diluted in one cubic centimeter of normal saline solution with one half per cent carbolic acid. One cubic centimeter is given as one adult dose. The following tables, published by Dr. Yanes, will show the results obtained in the Argentine and Cuban Armies with this "single high concentration dose."

ARGENTINE ARMY

Dosage Used (In Millions)

Year	No.	First	Second	Third	Total	Cases	Deaths	Per Thousand Effective
1916	3	100	300	500	900	173	43	9.50
1917	3	300	600	900	1,800	112	23	6.30
1918	3	500	1,000	1,500	3,000	31	8	1.62
	2	2,500	5,000	—	7,500			
1919	1	5,000	—	—	5,000	34	7	1.52
1920	1	5,000	—	—	5,000	23	—	1.01
1921	1	5,000	—	—	5,000	19	4	0.76

CUBAN ARMY

Dosage Used (In Millions)

Year	No.	First	Second	Third	Total	Effective	Cases	Per Thousand Effective
1921	3	500	1,000	1,000	2,500	12,188	24	1.96
1922	3	500	1,000	1,000	2,500	11,837	29	2.44
1923	3	500	1,000	1,000	2,500	10,049	18	1.79
1924	3	500	1,000	1,000	2,500	9,982	9	0.90
1925	1	5,000	—	—	5,000	10,564	8	0.75
1926	1	5,000	—	—	5,000	11,240	6	0.53
1927	1	5,000	—	—	5,000	11,273	7	0.62

Another question that arises is whether the vaccine should be given during an epidemic (i.e., during a period of exposure); as immunological investigations seem to show that there is a negative phase or drop in the opsonic power of the blood (in the opsonic index) immediately following vaccination, which implies a temporary diminution of immunity—and this negative phase is increased when the dosage of vaccine administered is increased (cit. #2). However, this negative phase has been denied by many investigators; and, according to Fleming and Clemenger (cit. #2): *In prophylactic vaccination, also, there is the advantage that large doses can be administered; as the temporary diminution of immunity, which, as will be shown later, follows the administration of a large dose, is of no consequence, provided it is later followed by a compensating wave of increased immunity.* W. Spat (cit. #3), however, reporting an outbreak of typhoid fever in a Jugo-Slav garrison, states that a group of fifty men who drank infected water developed the disease, although they had been previously vaccinated; and expresses his belief that: *typhoid vaccination shortly before exposure to infection does not protect against typhoid and may even increase the severity of the disease. The use of typhoid vaccination during an epidemic is, in his opinion of questionable value.* Yanes (cit. #1), on the other hand, states that: *the results observed following high concentration dose inoculation in certain Argentine Army groups known to have drunk infected water without the appearance of latent typhoid outbursts would indicate that the negative phase may be disregarded in prophylactic vaccination as of no practical importance.*

In actual practice it would appear to have been definitely determined that such fall in the opsonic index may be disregarded, as large group vaccination during epidemic periods in many instances has not been followed by an increase of cases among those vaccinated. It is our practice to vaccinate all the members of the family and immediate neighbors of every case of typhoid that comes to our notice; and, notwithstanding the fact that many of these individuals have been exposed to the infection, in not a single instance has the disease developed in those so vaccinated.

In view of these facts, it was decided to attempt in Banes the vaccination of the civil population with a single dose of vaccine of higher concentration. The vaccine prepared by the Cuban Department of Health, which is the one used, contains 1,000,000,000 dead bacilli per cubic centimeter; and we quote below information kindly given to us by the Director of the Laboratories of the Department as to its preparation. He says:

> In this Laboratory we manufacture two kinds of antityphoid bacterin—the one in series, which is the one currently used; and the "single dose" bacterin, which is only prepared by special request and is little used.
>
> In the preparation of either one of these two kinds of bacterins, we employ four different strains of bacillus Eberth—two of North American origin and two obtained in this country, these last two having strong antigenic power, as proven by tests in laboratory experimental animals.
>
> These germs are planted separately in simple agar with a pH of 7.2 to 7.4, in Kole jars that are incubated for 24 hours at a temperature of 37.5°C.
>
> When an abundant growth has been obtained, the colonies are emulsified in sterile physiologic saline solution, these emulsions are mixed in one or more jars, being now the product of the four strains of Eberth's bacilli already mentioned. These jars are now exposed to a temperature of 56°C. for one hour, in order to kill the germs and the millions of bacteria per jar is then measured by Hopkin's method, and we have now the standard bacterin.
>
> Knowing the number of bacilli in the standard bacterin, dilutions are then made with sterile physiologic saline, to obtain the type of bacterin wanted; for the "serial" bacterin the standard bacterin is corrected until 1,000,000,000 bacilli per cubic centimeter is obtained, or for the simple dose bacterin until three or four billions bacilli per cubic centimeter is obtained. Then Trikresol solution two per thousand is added.
>
> Once the bacterins are bottled cultures are made and guinea pigs inoculated with the different lots to determine that they are free of contamination.
>
> Periodically, tests are made to determine the immunizing power, following the methods recommended in Bulletin No. 10 of the Hygienic Laboratory in Washington.

As it did not seem advisable to use five cubic centimeters of the vaccine at one dose, and as a vaccine of equal concentration to that of the Army was not available (i.e., one containing 5,000,000,000 bacilli per cubic centimeter), it was decided to give two and a half cubic centimeters as the average adult dose. By this means, we were injecting 2,500,000,000 bacilli (half the Army dose) in a normal male adult. Female adults were given the same dose, if they appeared healthy and well developed. The vaccinator, however, uses his discretion; and reduces the dose to two cubic centimeters (2,000,000,000 bacilli) when the health of an individual seems to be somewhat below par. Although it is recommended that the dose in children be based upon body weight, this is quite impractical when dealing with mass vaccination and seems to be quite unnecessary. We grade their dosage according to age, as follows:

10 to 15 years	2 c.c., or 2,000,000,000 bacilli.
6 to 10 “	1½ c.c., or 1,500,000,000 bacilli.
3 to 4 “	1 c.c., or 1,000,000,000 bacilli.
Up to 3 “	½ c.c., or 500,000,000 bacilli.

The contraindications to the use of the single dose of vaccine are the same as those applying when the three dose method is used.

The reactions following the use of this single injection with larger dosage have not been more severe than those reported following the use of the three injections of lower dosage. During the year 1931, there were given in the Banes area 8,120 single high dose vaccinations, in which were included men, women and children; and we have yet to hear of one case which had untoward results.

Of course, we do not know at this writing what the actual practical results of such single dose inoculations will be; since these vaccinations have been made within the year. In forty-two typhoid fever admissions to the Banes Hospital during the year 1931, there were two cases who had been vaccinated previously with the single dose. As the occurrence of typhoid fever in a certain percentage of vaccinated cases are everywhere reported, this is of no significance. But because of this uncertainty it was decided, in order to determine if possible the efficiency of the vaccine so administered, to run a number of agglutination tests among those vaccinated, on the assumption that the presence of specific agglutinins in the blood implies the development of some immunity to the disease. Our tests were run in dilutions of 1:100 to 1:800. In some of the positive cases, agglutination occurred in dilutions 1:100 to 1:400; in the others, up to 1:800. But in all the positive cases, the strongest agglutination occurred in dilutions 1:100. Table I lists 18 cases who had been previously vaccinated; and shows the results obtained.

Case No. 16 was vaccinated every year from 1920 to 1930. Case No. 17 was vaccinated about three years ago, but she did not recall the exact date.

Case No. 18 merits special comments. She was vaccinated on June 16; and had a negative agglutination reaction five months later, on November 25th.

TABLE I

Number	Case	Race	Sex	Age	*Date of Vaccination	Date of Widal	Result
1	P. G.	C.	M.	40	June 5	Nov. 11	Positive
2	M. M.	C.	F.	17	“ 5	“ 11	“
3	F. M.	C.	F.	20	“ 10	“ 11	“
4	R. F.	J.	M.	34	“ 24	“ 11	“
5	J. G.	C.	F.	48	“ 10	“ 11	“
6	M. M.	C.	F.	22	“ 10	“ 12	“
7	J. M.	C.	F.	18	“ 27	“ 12	“
8	F. C.	C.	F.	50	Nov. 6	“ 12	“
9	B. M.	C.	M.	33	Aug. 20	“ 12	“
10	S. R.	C.	F.	42	July 1	“ 12	“
11	R. M.	C.	M.	14	June 10	“ 12	“
12	E. R.	C.	M.	21	July 1	“ 12	“
13	C. R.	C.	F.	19	“ 1	“ 12	“
14	C. P.	C.	F.	42	Oct. 20	“ 25	“
15	E. D.	J.	M.	38	“ 20	“ 25	“
16	B. T.	C.	M.	39	June 15	Oct. 16	“
17	S. E.	C.	F.	22	1929 (?)	“ 19	“
18	R. A.	C.	F.	19	June 16	Nov. 25	Negative
						Dec. 20	“
					Dec. 21	Jan. 7	Positive

C. = Cubans. J. = Jamaicans. * = All vaccinated in 1931, except Case No. 17.

A second test was made December 20th, as a check; and it was again negative. She was re-vaccinated December 21st; and a third test, which was made on January 7th, 16 days later, gave a frankly positive reaction. This case may, perhaps, be an illustration of those cases that develop typhoid fever in spite of vaccination. Due to some error in technique, in the dosage, or in the inability of the organism to react normally to the inoculation, they fail to develop the specific antibodies; although it is possible that the agglutinins may have disappeared from the blood, as they are expected to do in a few months, even though she had acquired immunization. Whatever the explanation, this case is suggestive.

Table II lists seven cases in which a Widal was made prior to vaccination and following vaccination. They were all negative before vaccination, and strongly positive six days or thirteen days later.

TABLE II

Number	Case	Race	Sex	Age	Widal Nov. 25	Date Vaccinated	Widal Dec. 1	Widal Dec. 8
1	G. J.	Jamaican	Male	37	Negative	Nov. 25	Positive	
2	J. C.	“	“	29	“	“ 25	“	
3	E. J.	“	“	32	“	“ 25	“	
4	G. K.	“	“	38	“	“ 25	“	
5	P. G.	Cuban	Fem.	56	“	“ 25		Positive
6	D. E.	“	“	33	“	“ 25		“
7	A. Z.	“	Male	16	“	“ 25		“

CONCLUSIONS

1. Mass vaccination, by the method which requires three injections of typhoid vaccine at weekly intervals, is impractical in a civil population.
2. The use of a single high concentration dose has proved effective in the Argentine and Cuban Armies, and should prove efficient in obtaining mass immunization.
3. The so-called "negative phase" may be disregarded in prophylactic antityphoid vaccination.
4. The results obtained in Banes, with the single high concentration inoculation, show that such high dosage is innocuous.
5. The results of agglutination tests, made before and after vaccination with this single high dose, seem to indicate that there is some reaction in the immunological mechanism of the body resulting in the formation of specific antibodies.

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THE DIPHTHERIA SITUATION IN THE BANES DIVISION

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During the year 1930, eleven cases of diphtheria were admitted to the Hospital in the Banes Division; and one case was treated in the Out-patient Clinic. Seven of these cases came from the village of Los Angeles, situated about five miles from Banes; and, of these, five were admitted during a period of three weeks (July 16 to August 4th, inclusive). Upon inquiry, the writer was advised that this locality was an endemic focus of the disease; and it was thought advisable to make a survey of the situation, especially of this village, in order that well planned measures of control might be instituted should the conditions necessitate such action.

A study of the number of cases reported from this Division in previous years, and a comparison with the figures for all the 10 Company Divisions, as shown in

CHART I

CASES DIPHTHERIA REPORTED—UNITED FRUIT COMPANY

	Banes Division				All Divisions			
Year	Hospital Admissions	Dispensary Cases	Total Cases	Deaths	Total Cases	Deaths	Cases and Deaths by Divisions	
1918	—	—	—	—	6	—	Preston Colombia Costa Rica	3 1 2
1919	2	4	6	1	9	1	Banes Preston Colombia	6 (1) 2 1
1920	4	—	4	1	11	2	Banes Preston Colombia Costa Rica	4 (1) 1 4 2 (1)
1921	2	21	23	—	27	—	Banes Preston Colombia Panama	23 2 1 1
1922	—	41	41	—	47	—	Banes Other Divs.	41 6
1923	4	13	17	—	23	—	Banes Other Divs.	17 6
1924	2	6	8	—	12	—	Banes Other Divs.	8 4
1925	1	—	1	—	4	—	Banes Preston Costa Rica	1 2 1
1926	1	—	1	—	3	—	Banes Preston Colombia	1 1 1
1927	1	—	1	—	6	1	Banes Jamaica Costa Rica Tela	1 1 1 3 (1)
1928	10	—	10	1	17	2	Banes Panama Tela	10 (1) 1 6 (1)
1929	8	—	8	—	13	—	Banes Preston Colombia Panama Chiriqui Tela	8 1 1 1 1 1
Total. . .	35	85	120	3	178	6		

Note: Bracketed figures in last column, record the number of deaths.

Chart I, reveals that out of a total of 178 cases reported for all the Divisions in the twelve-year period extending from 1918 to 1929 inclusive, there were 120 or practically two-thirds (67.41%) reported from Banes, and 58 or roughly one-third (32.59%) from all the other Divisions. Even though the number of cases are so few, this tabulation shows that Banes is the Division where this disease is most prevalent. The adjoining Preston Division, where conditions are most similar to Banes, reported only 12 cases during this period. There is, however, one marked difference between the two Divisions; and that is the character of the population. Whereas a large native town is within the boundaries of the Division in Banes, there is no such town in the Preston Division; and, whereas small areas of land operated by independent owners are located at various points throughout the Banes Division, the Preston Division is quite isolated and self-contained. That is, crowding is a feature of Banes; while in Preston the population is more scattered.

CHART II
LOCATION OF RESIDENCES OF DIPHTHERIA CASES—BANES DIVISION

Location	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	Total	Estimated Population	Percentage
Banes.	—	3	—	17	20	10	3	—	—	1	5	7	3	69	15,847	0.43%
Macabi	—	—	—	2	15	3	—	1	—	—	—	1	—	22	762	2.88%
Embarcadero . .	—	2	—	—	—	1	—	—	—	—	5	—	—	8	492	1.62%
Los Angeles . . .	—	—	—	1	5	3	—	—	—	—	—	—	7	16	605	2.64%
Deleite	—	1	—	1	—	—	3	—	—	—	—	—	—	5	831	0.60%
Negritos	—	—	—	2	1	—	2	—	—	—	—	—	—	5	178	2.80%
Mulas.	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	
Veguitas	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	
Steamship	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	
Unknown	—	—	4	—	—	—	—	—	—	—	—	—	—	4	—	
Total	—	6	4	23	41	17	8	1	1	1	10	8	12	132	—	—

However, an average of 10 cases per year in Banes, and of 17 cases per year for all the 10 Divisions combined, shows that diphtheria is not a menacing disease in the United Fruit Company's Divisions. However, the fact that there is some factor which prevents the greater spread of the disease, but which is not powerful enough to cause its complete disappearance, is a challenging problem. The inference would be that diphtheria bacilli in these latitudes are normally non-virulent, and that only under certain provocation do they become actively pathogenic. What factor causes this change remains to be determined.

Of the 120 cases reported from Banes during this 12-year period, 81 or 67.5% were reported during the three years of 1921, 1922 and 1923 (23, 41 and 17 cases respectively), representing a mild epidemic outbreak. That the disease assumed a mild form, is attested by the fact that there were no deaths attributable to it; and that only 2 cases were admitted to the Hospital in 1921, none in 1922, and 4 in 1923. Since 1928 there has been an average of ten cases admitted to the Hospital each year.

In trying to determine from which locality in the Division most of the cases came, we find, as shown in Chart II, that, in the thirteen-year period 1918–1930, with a total case record of 132, the number of cases for each locality corresponds rather closely to the estimated population. Banes, Macabi and Los Angeles, which had most cases, also show that the bulk of them occurred in the years 1921, 1922 and 1923. Without a doubt, a great many more cases must have occurred in Banes; but they were treated by local physicians, and did not come to the attention of the Hospital Medical Staff. From these data, we must conclude that there is no one locality in the Division more heavily infected than any other; and that, if the village of Los Angeles has shown most cases this year, this was due to a series of contact cases following the appearance there of some particularly virulent carrier.

A study of the eleven cases admitted to the Hospital during the year 1930 shows that 7 came from Los Angeles, 3 from Banes, 1 from Veguitas (an isolated camp), and 1 from Mulas (isolated camp). The twelfth case seen was treated in the Dispensary (culture and smear were positive for diphtheria bacilli); and recovered promptly, following the use of serum.

REPORTS OF FATAL CASES

Two cases died, of those admitted to the Hospital.

Hospital Case No. 698.—A Cuban child, 11 months old, from Mulas, who had been ill at home for many days and was only brought to the Hospital when he showed signs of intense intoxication and dyspnea, was admitted at 9 a.m., and died at 10 p.m. that evening. Intubation and 10,000 units of serum were of no avail.

Hospital Case No. 986.—A Jamaican child, 8 years old, from Banes, who had been ill at home for seven days prior to admission, was very ill on admission at 9 a.m. and died at 9 a.m. the following morning notwithstanding massive doses of serum.

These deaths were clearly due to the fact that the patients did not receive prompt and adequate treatment.

CASES REQUIRING SURGICAL INTERFERENCE

The other 9 cases recovered promptly following the administration of serum; with the exception of two cases which required immediate tracheotomy, and in both of which the tracheotomies were without doubt the means of saving life. Both of these cases came from Los Angeles:

Number I.—Cuban, 3-year-old boy. The first day he was given 20,000 units of antitoxin. He was so much better on the second day that no antitoxin was given. On the morning of the third day, however, he became almost asphyxiated; and, intubation being tried without success and his condition being most serious, he was taken to the operating room following the injection of 20,000 units of serum. Tracheotomy was performed, following which he had an uneventful recovery without further treatment. The tube was removed on the seventh day following operation, and the child was discharged on the twelfth day following admission.

Number II.—Cuban, 8-year-old girl. She had been ill at home for one week with, the mother said, a "bad cold." On admission she was cyanotic and intensely dyspnoeic, and 10,000 units of antitoxin were administered immediately; but her condition was so serious that immediate tracheotomy was indicated and performed, following which all urgent symptoms disappeared. The temperature, which was 102°F. on admission, went to 104°F. the next day; and dropped promptly to 99°F. on the third day. That evening, however, she had a rise to 101°F., and for 17 days had an irregular, septic type of temperature which finally disappeared on the 18th day. After this, the patient had an uneventful recovery.

The explanation of this rise in temperature was found on the sixth day after admission; when it was noticed that the right ankle was swollen and painful, and affected with an acute arthritis. On the thirteenth day, seeing that the temperature curve would not remit, it was decided to use foreign protein therapy. Injections of Omnadine (Bayer) were given on the 13th and 15th days; and, on the 17th day, 5 c.c. of sterilized milk. Temperature was normal on the 19th day, and remained normal.

Tracheotomy tube was removed on the 10th day. Patient had an uneventful recovery.

EPIDEMIOLOGY

It has not been possible to find any definite previous case, to explain the occurrence of the two cases admitted from Banes and of the two cases from the isolated camps of Mulas and Veguitas.

The seven cases from Los Angeles were all inter-related, and all occurred among members of three families. They could be attributed to contact from the first case, as the following histories indicate:

Case I.—Date of admission, February 13. An 18-year-old Cuban laborer, living with mother and sister, neither of whom had been ill. They were unable to recall any previous case among their contacts.

Case II.—Date of admission, May 5, three months after case I. This was a seven-year-old Cuban girl, living with her parents who have resided in the same house for 15 years. They have had 9 children, of whom 3 are dead—the causes of death are unknown. This case could be connected with case I by the fact that this patient visited the house. Three of the children in this family contracted diphtheria.

Case III.—Date of admission, July 16; two months after case II. A three-year-old child, brother of case II (tracheotomy case).

Case IV.—Date of admission, July 26 (tracheotomy case). This was the eight-year-old niece of case I; and she frequented his house to visit her grandmother, who is the mother of and living with case I. It occurred five months after case I, and would seem to have been derived therefrom. Case I also visited her house frequently. This girl lives with her parents and seven brothers and sisters. Of the seven children, two had diphtheria.

Case V.—Date of admission, July 28. Two-year-old sister of cases II and III.

Case VI.—Admitted, July 29. Five-year-old brother of case IV and nephew of case I.

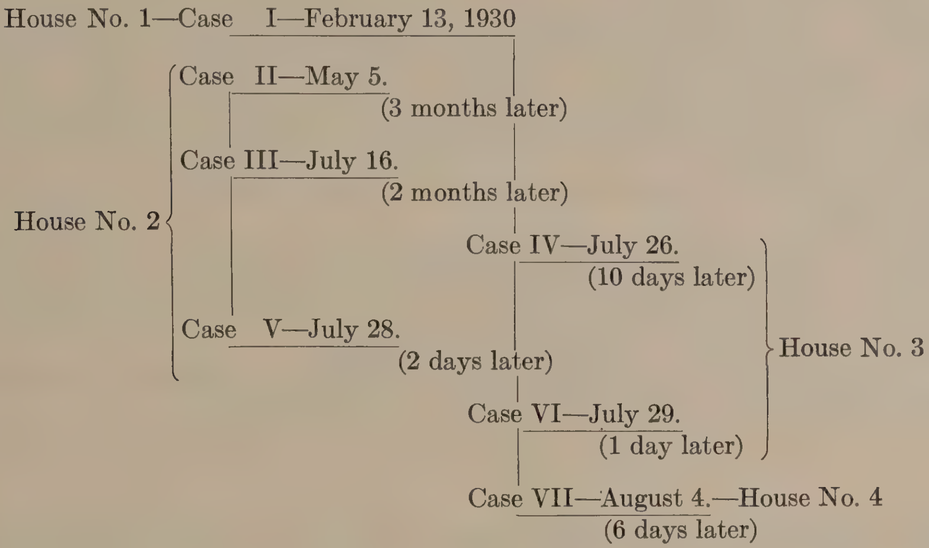
Case VII.—Admitted, August 4. Three-year-old child who lives in the house next door to cases IV and VI. She lives with her parents and seven brothers and sisters of whom she was the only one infected.

Following this case, no other cases developed; notwithstanding the fact that these cases live in houses where there are many other children. In this respect it should be noted that, whenever one of these cases appeared, all the children in the house were given passive immunization by the injection of 1500 units of anti-diphtheria serum. Whether this measure is the reason for the abrupt cessation of the outburst or not, I do not know. It has also been suggested, and we are recommending the practice, that all persons living in a home where a diphtheria case occurs and all diphtheria cases after discharge be treated by daily throat swabbing with mercurochrome 5% solution, or with gentian violet. Dr. Parks of New York, however, claims that saline gargles are just as efficient; and W. C. Harvey also thinks that the best medical treatment of carriers is nasal douching with mildly alkaline solution.

SUMMARY

To sum up, we may say that:

1. The curious thing about the cases occurring in Banes, in the year 1930, is the length of the period elapsing between one case and another; this period being very long in the earlier cases and shorter in the later ones, as follows:



2. Diphtheria is more common in Banes, Cuba, than in any other United Fruit Company Division.

3. Diphtheria is not a menacing disease in these areas; the number of cases being few, and most of them being mild.

According to Taliaferro, tests made among various groups of children in Tela, Honduras, showed a much lower percentage of positives than in large centres in the United States; and comparison between groups of children belonging to the better class of employees and those of the lowest class showed a much lower percentage of positives in the latter. This he explains by presuming that immunity will be higher where conditions of living are worse and people live more crowded together. Such poor conditions of living would be one explanation for the low rate of diphtheria in these countries.

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SUPPLEMENTARY DATA—1931

During the year 1931, only 2 cases of diphtheria were admitted to the Hospital:

Case I.—Date of admission, March 28. A Cuban, female child, 16 months old, from Los Angeles. Four days before admission, she had had fever and difficult, stertorous breathing. On admission, she showed intense inspiratory dyspnoea; her cheeks and lips were cyanotic; and there was a small, white membrane over the right tonsil. Throat culture for diphtheria bacilli was positive. Immediate tracheotomy was indicated, and was performed shortly after admission; and 10,000 units of anti-diphtheric serum were given on the first day, and 20,000 units on the second day. The patient had an uneventful recovery.

Epidemiology: No connection could be found between this case and those which occurred last year.

Case II.—Date of admission, August 26. A Cuban, female child, 8 years old, came from the local Banes town. The patient had been ill at home for 4 days before admission, with sore throat and general malaise. Upon admission, patient was suffering from dyspnoea. She had a grayish, purulent exudate from tonsils and fauces; enlarged submaxillary lymph glands; coated tongue; and tachycardia.

Diagnosis: Diphtheria. On the first day, 10,000 units of anti-diphtheric serum were administered; and a similar injection was given on the second day.

Epidemology: No connection with any previous case could be established.

THE CLINICAL SYMPTOMATOLOGY OF ANKYLOSTOMIASIS

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The diagnosis of uncinariasis made by a microscopic examination of the stool is the most convenient and the most certain; and eliminates the necessity of a physical examination and prolonged questioning of the patient by the physician. In a hospital, where the examination of the stool is done routinely on all patients, the diagnosis is furnished by the laboratory soon after the admission of the patient; and it is not necessary to consider the symptomatology of uncinaria infestation. Only a relatively small number of patients are hospitalized solely for hookworm disease. In the great majority of the cases, the diagnosis and treatment of the acute primary condition for which the patient is admitted is of considerably more concern to the physician and completely absorbs his interest; and, in consequence, the administration of chenopodium, which is prescribed in all cases whose stools are positive for uncinaria ova, is a routine procedure of comparatively minor importance. It is in this way that the characteristic symptoms of this most common tropical disease pass unnoticed by a great number of physicians attached to the staffs of institutions. On the other hand, the doctor who is practicing in rural districts, with no microscope to aid him, gradually learns from observation the group of significant clinical signs and symptoms which rarely leave him in doubt as to the diagnosis. I shall briefly outline these symptoms, and attempt to arrange them in the order in which they appear:

We have, in the first place, the violent headaches and dizziness. The headache is usually localized in the frontal region towards the temples, and appears "as the sun gets hotter." The dizziness is most pronounced when the patient stoops and then rises. He feels as though everything around him is turning, and his vision becomes hazy—he describes it as "looking in the dark."

Next in frequency to the two symptoms described above are fatigue and pains in the knees; and these are the symptoms of which the patient most commonly complains to the doctor. The patient, possibly young and robust, relates that for the last two or three weeks he has been unable to endure his habitual work; that he tires quickly; and that the slightest amount of walking produces pains and weakness in the knees—especially in mounting any incline. Very common also is the "pain in the waist," localized in the lumbar region on both sides, which hinders the patient in stooping and rising rapidly. How many "lumbago" cases tenaciously resist salicylate treatment for years; and then disappear quickly with the expulsion of ankylostoma!

Sleepiness is frequently the sign first observable at the outset. The patient is sleepy all day, and has no desire to do anything else but sleep.

Violent palpitation of the heart appears at an early stage. At first it is noticeable only from walking or from brisk efforts, but subsequently it is evident at all hours and even while the individual is resting.

In conclusion, I shall mention three symptoms which almost never fail to appear—even from the beginning of the ailment.

1. Pains in the stomach; which are localized in the epigastric region or towards the umbilicus, are increased on pressure of the hand, and are often accompanied by indigestion or a sensation of fullness after meals.

2. Mild diarrheas, which are irregular in appearance and sometimes alternating with constipation.

3. The condition that the rural Costa Rican graphically terms "watering of the mouth." This arises not only from salivary hypersecretion, but also from regurgitation of bitter and viscous gastric contents which surge from the patient's stomach and fill the mouth when he stoops.

With the advancement of the disease, these symptoms become more pronounced; and others appear, among which anemia occupies first place. The skin pallor increases, and assumes an earthy color; the face becomes puffed; and fleeting or persistent edemas appear here and there—on the eye-lids, on the ankles, and on the instep of the feet. The pulse throbs rapidly and lightly; and systolic or diastolic murmurs begin to appear over the heart, and are so accentuated at times that they may be mistaken for cardio-valvular disease. (In one instance, I saw the systolic murmur disappear completely a few days after administering a vermifuge.) The temperature shows a slight daily variation. The pains in the knees continue, and similar pains appear in other regions so that the patient complains of "pains in all the bones." In almost all of the advanced cases of hookworm, I observe an atrophy of the mucous membrane of the tongue; which causes it to appear smooth and glossy, as in pernicious anemia. Recurrent diarrhea appears; the attacks become more frequent and more acute, and are sometimes dysenteric in character and accompanied by tenesmus, abdominal pains, and passing of mucus and blood in considerable quantities.

It is as difficult to say how many of the foregoing symptoms can be attributed to anemia, as it is to explain the cause of the anemia itself by ascribing it solely to the relatively insignificant losses of blood which the hookworms extract. The pallor, the edemas, the cardiac irregularities, the atrophy of the mucous membrane of the tongue, etc., may be considered as simple manifestations of anemia; but the toxic symptoms manifested by the violent headaches, dizziness, pains in the knees and elsewhere, fatigue, and sleepiness, appear constantly in hookworm infection long before an appreciable degree of anemia has been established; and unquestionably the toxins produced by the intestinal worms play an important part in the production of these symptoms, just as the inflammation and atrophy of the gastro-intestinal mucosa determines the digestive troubles.

Editor's Note.—The remarks made in this article pertain primarily to conditions existing on the plantations of the United Fruit Company, where all hospital patients are routinely treated for hookworm infestation. Under such circumstances, the degree of infestation is naturally kept low; and consequently the hospital cases in which hookworm is the primary cause of hospitalization are rare, and the mortality rate from this disease is practically nil. The observations of Drs. Louis Schapiro and Ernst G. Nauck (The American Journal of Hygiene, Vol. XIV, No. 3, November, 1931) indicate that in other parts of Costa Rica hookworm infestation is responsible for a comparatively high rate of morbidity, and is not infrequently the cause of death; and, furthermore, that *A. duodenale* as well as *N. americanus* are present to a considerable extent in Costa Rica.

LOBAR PNEUMONIA

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As has been the annual custom for several years, a review of the cases of lobar pneumonia treated during the current year has been made. There were few changes on the medical staff, and most of the cases were treated on the services of two physicians.

The average number of persons dependent on the hospital for treatment was 7,313; this being a decrease of 1,622 persons over 1930. Of three cases admitted from locations whose populations are not included in our census, two cases were cured and one died.

The total rainfall in 1931 was 29.11 inches more than in 1930. The mean temperature for 1931 was about the same as in 1930. We have never been able to demonstrate a relation between the incidence of lobar pneumonia and the climatic changes of the seasons of the year.

TABLE 1

COMPARISON OF MORTALITY RATES

Year	No. of Cases	No. of Deaths	Per cent
1921	31	8	25.80
1922	60	39	65.00
1923	97	52	53.61
1924	101	43	42.57
1925	100	30	30.00
1926	63	23	36.50
1927	55	21	38.18
1928	76	30	39.47
1929	89	17	19.10
1930	56	16	28.57
1931	46	16	34.78
Average, 11 years	70.4	26.8	38.12

TABLE 2

SEASONAL INCIDENCE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
No. of cases	5	9	4	—	2	8	5	1	2	3	2	5	46
No. of deaths	1	6	—	—	1	2	2	—	1	2	—	1	16
Per cent	20.0	66.7	—	—	50.0	25.0	40.0	—	50.0	66.7	—	20.0	34.78
Av. rainfall (in.). . . .	8.05	5.94	8.28	6.85	4.87	8.53	10.16	12.14	9.43	13.24	16.88	6.07	110.44
Temperature (mean) . .	80.0	77.0	78.5	77.0	81.0	81.0	81.0	80.0	81.0	80.5	77.5	80.0	79.54

TABLE 3

CASES BY NATIVITY

Nativity	No. of Cases	No. of Deaths
British Honduras	1	—
Costa Rica	1	—
Guatemala	1	—
Honduras	32	13
Nicaragua	3	1
Salvador	6	1
Spain	1	—
Unknown	1	1

TABLE 4

CASES BY SEX AND STATUS

	Males		Females		
	Employees	Non-employees	Employees	Non-employees	Total
No. of cases	31	5	—	10	46
No. of deaths	10	2	—	4	16
Per cent	32.25	40.00	—	40.00	34.78

As usual, no cases of lobar pneumonia occurred among local residents coming from the temperate zone; but a Spanish seaman from a ship calling at our port was treated for this disease, which he had developed at sea, and recovered.

COMMENTS

Our patients came from 24 distinct and well separated localities which have very little contact. The greatest number of cases (7) came from the port town where a large part of the population is concentrated. With the exception of one farm where three (3) cases developed, the remaining cases were evenly distributed thru the districts.

The average period of hospitalization was 18¼ days or a total of 840 hospital days; but this included cases hospitalized 55, 59 and 86 days, respectively, on account of complications, and also several cases who died very soon after admission.

The Spanish sailor, mentioned previously, developed a thrombophlebitis in the left leg on his 10th day in the hospital, but was discharged as cured on the 59th day after admission.

Three (3) cases developed pneumonia while in the hospital under treatment for other conditions; and all three died. The first case was under treatment for amebic dysentery, and developed pneumonia on the 12th day; the second case was under treatment for E. A. malaria, and developed pneumonia on the 5th day; the third case was under treatment for E. A. malaria, with a mild bronchitis, and developed pneumonia on the 5th day. In the first instance, there were two acute pneumonia cases and two convalescent pneumonia cases on the same ward, but not in adjoining beds; in the second instance, there were two convalescent and one acute pneumonia cases on the same ward, but not near; in the third instance, there were no other pneumonia cases in the hospital. It is always well to bear in mind that pneumonia is contagious and that cross infections are especially dangerous.

POST MORTEM FINDINGS

Eight of the fatal cases came to autopsy. In all of these instances, the pneumonia, as well as most of the complications, had been properly diagnosed. The gross findings are noted below:

Case #1. Involvement of the right lower and middle lobes; chronic splenitis; passive hyperemia of liver; hydronephrosis.

Case #2. Involvement of right upper lobe; bronchopneumonic areas in left lung; dilatation of right heart; splenomegaly; E. A. malaria; uncinariasis.

Case #3. Involvement of the left lower, right lower and middle lobes; splenomegaly; uncinariasis; ascariasis.

Case #4. Involvement of the whole right lung and the left lower lobe; small empyema of right pleural sac; acute myocarditis; chronic splenitis.

Case #5. Involvement of the right upper lobe only; chronic splenitis.

Case #6. Complete involvement, in different stages, of both lungs; acute myocarditis; dilatation of heart.

Case #7. Involvement of the right upper and lower lobes; fatty degeneration of the liver; parenchymatous nephritis.

Case #8. Involvement of the right upper and lower lobes; acute myocarditis; acute nephritis.

TREATMENT

The treatment administered was almost entirely symptomatic, and included a variety of drugs and therapeutic measures.

One case developed an empyema which was eventually cured by repeated aspirations of the pus, irrigations with Dakin's solution, and injections of 2% mercurochrome solution and of Rivanol into the pleural cavity. He developed a severe stomatitis, presumably from the mercurochrome.

Dextrose, in doses of 50 c.c. of 50% solution given with normal saline solution, was administered intravenously in two cases, one of which died. The use of large quantities of solution intravenously in these cases is of doubtful value, on account of the load thrown upon the heart. The concentrated solution (50%) of dextrose should be injected very slowly.

Mercurochrome, in doses of 20 c.c. of a 1% solution, was given intravenously in 13 cases. Ten of these cases were in the acute stage and, of these, two died. The remaining cases were of unresolved pneumonia in the 20th, 34th and 54th days, respectively; and these recovered promptly.

SEVERE ANEMIA IN PREGNANCY

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The combination of pregnancy and anemia are seen frequently in tropical countries. The anemia is generally caused by chronic malaria. The destruction of the blood often reaches high degrees in native pregnant women, as they take very little or no quinine for malaria because they are afraid of the abortive effects of this remedy and do not take into consideration the abortive effect of malaria itself.

A slight degree of anemia does not generally affect the pregnancy; while severe degrees lead to abortion or miscarriage, and often cause the death of the mother also. Sometimes, however, a grave prognosis for child and mother is not justified. I wish to show this in the following case:

CASE REPORT

D. E., 18 years of age, Salvadorean; was about 8 months pregnant. The exact date of the last menstruation was not known, the menstruation having been very irregular at all times. She had suffered all her past life from anemia, and treatment had never shown much effect. She has one well-developed boy about 4 years of age. She had been troubled for several weeks with swelling of the feet; and this had increased to such an extent that she had to enter the hospital for treatment.

Physical Examination.—(August 31, 1930). Very anemic but well-developed native woman, with pronounced edema of the face, legs, arms and vulva. The lungs were normal. There were systolic murmurs over all of the heart valves. The pulse rate was 100 per minute. The uterus indicated that she was in the 9th month of pregnancy. The child was in left occipito-anterior position and the foetal pulse rate was 120 per minute. All parts of the child were felt easily through the abdominal and uterine wall, as tho there was very little amniotic fluid. The spleen and liver were apparently not enlarged.

Laboratory Examination: erythrocytes 900,000; leucocytes 12,800; small and large lymphocytes 26%, neutrophiles 74%, eosinophiles negative. Pronounced anisocytosis, poikilocytosis, and polychromatophilia were noted. The hemoglobin was 25%; the blood was negative for malaria; the Meinicke test was negative. The urine was normal and the stool showed merely a few ova of uncinaria.

Treatment.—Digitalis, arsenic injections, and liver diet were prescribed.

Development.—The edema disappeared completely within 10 days. The temperature never rose above 99.5 degrees F. On a few days she felt what she believed to be slight labor pains, but had improved so much after 10 days of treatment that she decided to go home. Five days later (Sep't 16) she was re-admitted on account of labor pains. Her general condition was about the same as at the time of the first admission; the edema had developed again to a marked degree; and the pulse rate was up to 120. She had no fever. The urine was negative. Blood examination: erythrocytes 1,000,000; leucocytes 10,700; hemoglobin 30%; lymphocytes 28%; neutrophiles 68%; large mononuclears 4%; normoblasts, 2 to every 100 white blood cells. Pronounced anisocytosis, poikilocytosis, and polychromatophilia were noted.

Treatment.—Arsenic and digitalis were again administered. For 2 days, there was persistent vomiting without known cause. On the 19th of September, there was a normal delivery of a male child weighing 4 pounds. The child showed all the signs of maturity. There was a moderate loss of blood during delivery. Examination of the blood did not reveal any changes after delivery, with the exception of the usual increase of leucocytes. The baby had hemoglobin 90% and erythrocytes 3,200,000, the day after delivery; and the differential blood count was normal. The mother had sufficient milk to nurse the baby. It gained four ounces within the first 9 days. The uterus involuted normally. The child and mother were discharged on the 11th day after delivery.

THE IMPORTANCE OF ALKALINE FOODS IN PREGNANCY

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PRELIMINARY REMARKS

In this report I shall not discuss the various causes of anemias and toxemias which affect the gravid woman; but merely wish to report a few cases treated in the Deleite Clinic, of the Banes Division, in which remarkable improvements were noticed following a change in their dietaries.

The usual diet of these patients was found upon inquiry to consist mainly in the excessive consumption of carbohydrate foods in the form of refined sugars, polished rice and bread; and, although meats were occasionally used, their diet was deficient in green vegetables, fresh fruits, tubers, beans, etc. In fact, they even had a dislike for these classes of food. Most of the patients came from the laboring class (cane cutters' wives), who, while not enjoying the same advantages as the higher class employees, have fairly good living conditions.

The age of the 7 patients varied from 17 to 36 years; 2 were primigravida and 5 were multigravida; and they were in varying periods of gestation. The symptoms of which they complained mostly, at the time of their first visits to the clinic, were: nausea, vomiting, constipation, headaches, tachycardia, dyspnea and edema. The physical examinations did not reveal symptoms of any other complicating disease, except hypertrophied tonsils and decayed teeth in some of the cases.

As this is a highly infected malaria region, routine blood examinations for malaria were made in all the cases with negative results. The hemoglobin estimation was no higher than 60% in any of the cases at the first examination, and in none higher than 75% up to the time of delivery. Five of the cases showed the presence of albumin in the urine at the first examination; but in two of these cases it disappeared before the second examination was made, while in one case (No. 4), albumin persisted until delivery. The examinations were made during the first visit to the clinic and subsequently, at frequent intervals, until delivery.

The following table shows the principal symptoms complained of, and the changes found in the blood and urine:

Case No.	Principal Symptoms	Examinations						
		Number	1st	2nd	3rd	4th	5th	6th
1	17 yrs. old; 3 mos. pregnant, I gravida; constant vomiting for a week, and constipation.	Date	7/3	7/20	8/15	12/30		
		Hemoglobin	60%	65%	65%	75%		
		Albumin	Neg.	Neg.	Neg.	Neg.		
2	22 yrs. old; 5 mos. pregnant, II gravida; occasional vomiting, constipation, tachycardia, and headaches.	Date	7/15	8/3	8/18	9/18	9/30	10/30
		Hemoglobin	55%	55%	65%	70%	75%	75%
		Albumin	++	Neg.	Neg.	Neg.	Neg.	Neg.
3	20 yrs. old; 4 mos. pregnant, II gravida; weakness, constipation, and nausea.	Date	8/15	8/22	9/1	10/29	12/20	
		Hemoglobin	60%	70%	70%	75%	75%	
		Albumin	Neg.	Neg.	Neg.	Neg.	Neg.	
4	24 yrs. old; 6 mos. pregnant, I gravida; tachycardia, general edema, dyspnea, and constipation.	Date	8/12	8/18	8/24	9/6	10/1	11/28
		Hemoglobin	45%	45%	50%	55%	55%	55%
		Albumin	+++	+++	++	++	++	++
5	33 yrs. old; 7 mos. pregnant, III gravida; discomfort, edema of ankles, and constipation.	Date	9/25	9/30	10/18	11/9		
		Hemoglobin	55%	60%	70%	70%		
		Albumin	++	+	Neg.	Neg.		
6	36 yrs. old; 7 mos. pregnant, IV gravida; painful micturition, occasional vomiting and headaches.	Date	9/11	9/23	10/20	11/7		
		Hemoglobin	50%	65%	75%	75%		
		Albumin	+	Neg.	Neg.	Neg.		
7	32 yrs. old; 8 mos. pregnant, III gravida; nausea, constipation, and edema of ankles.	Date	9/3	9/25	10/29			
		Hemoglobin	60%	60%	75%			
		Albumin	+	+	Neg.			

My experience is based not only on these seven cases, but on more than two hundred cases which have come to the prenatal clinic since 1928. These cases were selected because of the severity of the symptoms.

TREATMENT

These patients were instructed to consume tubers, green vegetables, fresh fruits, beans, peas and milk in abundance; while meats, eggs or fish were allowed in moderate amounts. The use of rice, bread and sugar were strictly forbidden. In addition, two ounces of a concentrated solution of magnesium sulphate was administered the first day; and repeated every week until delivery, if toxic symptoms and constipation persisted, so as to increase elimination. Those suffering with nausea or vomiting were advised to take ½ oz. every hour until the full dose was taken. Invariably, all patients felt better on the second visit, and the vomiting, nausea, headaches and constipation had disappeared. Other symptoms had invariably disappeared by the time of delivery; except in case No. 4, in which the edema and tachycardia persisted, though in less severe form, until a few weeks following delivery although she had an uneventful delivery and puerperium. In all the cases, labor was normal and normal infants were delivered.

SUMMARY

The distinct improvement in the clinical symptoms and the increase observed in the hemoglobin content and disappearance of albumin from the urine, after the patients had followed the diet described, would seem to indicate the importance of a diet rich in alkaline inorganic salts; which, while necessary at all times, is of particular importance in pregnancy, when it is especially beneficial to the mother and essential for the normal growth of the fetus.

CONCLUSIONS

Though I would not be understood as implying that the anemias and toxemias encountered in the course of pregnancies are always due to faulty diets, I am convinced that the toxic symptoms and the anemia present in this series of patients were the result of (a) the excessive consumption of cane sugar and the acid ash foods such as bread and polished rice; and (b) the lack of alkaline mineral salts in their food intake, which elements are derived from green vegetables, fruits, tubers, beans, etc.

The conditions of these patients do not seem to have been influenced by either the pregnancy or the period of gestation.

FOOT-ITCH

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After the well known triad, consisting of (a) malaria, (b) syphilis, and (c) the various intestinal parasites (principally uncinariasis); probably the commonest ailment for which patients apply for treatment in the out-patient clinics of our tropical hospitals, is *foot-itch*. Aside from dermatophiliasis occurring only in dry, sandy regions where tropical natives refer to it as "nigua" and where our white resident foreigners speak of it as "chigoe" or "jigger," the chief malady of this nature is one which produces either a violently itchy dermatitis between the toes or itchy blebs on the soles of the feet. This disease occurs in all parts of the tropical world; and in the temperate zone is so common during the warmer seasons that a now popular term has been applied to it for advertising purposes by some pharmaceutical firm which offers a form of treatment. When the patients apply for treatment in the dispensary clinics, natives and foreigners alike usually have their cases already diagnosed. In the American tropics, they will ask for some relief in the form of a salve, or wash, or powder for: "dhobie itch," "athlete's foot," "scabies," "seven-year itch," "ringworm," "spikety itch," "ground itch," or "masamora." On examination of these cases, two distinct types of infection are recognized. Castellani and Chalmers refer to them as (a) Dermatitis interdigitalis, and (b) Dermatitis bullosa plantaris.

Dermatitis interdigitalis begins with an intense itching between the toes. At this time, the skin is red and glossy; and milder cases do not progress beyond this stage. In the more severe forms, the itching becomes so intense that patients cannot seem to resist scratching themselves until they bleed. Oft-times they are awakened at night with intense itching and with an accompanying irresistible urge to scratch until blood exudes freely from the tiny abrasions that can be found at that time. After this, considerable desquamation may ensue; large, deep fissures may develop; and a weeping type of eczematous dermatitis may appear, to which the natives of the American tropics apply the term "masamora" which means a sort of soggy mush made of milk and ripe plantains. At this time, secondary infections sometimes cause more or less serious complications; and it is not uncommon for the toe-nails to become involved.

Dermatitis bullosa plantaris begins with the formation of blebs, varying in size from a millet seed to that of a split-pea. These appear usually on the plantar surface, but are also located frequently on the flexor surfaces of the toes. Their appearance is accompanied by intense itching; which is slightly relieved by rupturing the vesicle, from which a pale yellow fluid escapes. After this operation, the area rapidly dries and soon becomes covered with thin, scaly flakes of skin. Secondary infections, of varying degrees of severity, occasionally follow scratching or breaking of the blebs.

The etiological factor in the two disorders described above seems to be a secondary streptococcic condition, complicating a primary infection with a fungus called the Epidermophyton.

TREATMENT

Few diseases are subjected to so many forms of treatment. One patient told me that he wasn't particularly anxious to be cured, as he had always derived such keen pleasure in scratching his *foot-itch* that he was sure that he would miss it if he were really permanently cured. Permanent cures, however, are not so easily effected; and sometimes it is quite impossible to do more than give temporary relief. Byam and Archibald advise keeping the patients in bed. The different forms of pharmaceutical therapy that have been applied are:

(1) Bathing feet in a 1/2000 solution of potassium permanganate.

(2) Bathing feet in a 1/3000 bichloride of mercury solution.

(3) Bathing feet in vinegar; or in a 1 to 2 per cent acetic acid solution.

(4) Application of strong iodine to the lesions. I know of one individual who, for years, has placed pledgets of cotton soaked in strong tincture of iodine between the toes. He claimed that he experienced such excellent results from this treatment that he could not be induced to give it up for another.

(5) Mercurochrome (2% solution) applied to the lesions has given satisfactory results in a few cases.

(6) Kerosene. I know of one case which was most resistant to all other forms of treatment, but which improved most satisfactorily after a few applications of kerosene.

(7) Dr. K. P. A. Taylor, formerly connected with our Medical Department, reported good results from treatment with ethyl-chloride sprays, although he admitted of contra-indications to this treatment.

(8) Application of glycerin.

(9) An ointment, introduced by the late Dr. W. E. Deeks, gives excellent results in some cases. This consists of: Acid salicylic, 8; oil eucalyptus, 10; bismuth subnitrate, 10; ammoniated mercury, 4; lanolin q.s. ad. 100.

(10) Chrysarobin liniment (5%), applied cautiously, has given relief.

(11) Ammoniated mercury ointment (5%) has given excellent results in the vesicular type.

(12) Phenol (5% solution) has been recommended.

(13) Various dusting powders, such as thymol iodide, bismuth dusting powder, etc., have given indifferent results.

(14) Byam and Archibald advise: "*Put the patient to bed and dress the affected area with ½ per cent carbolic lotion, and later apply an ointment of Bismuth Subnitratis, grs. 30; Acid Borici grains 15; Vaselini and Lanolini of each 1 oz. Only white stockings should be worn and they should be changed twice daily, and boiled before further use. If a fungus is suspected, and the lesions are dry, tincture of iodine may be used.*"

The above is recommended for the interdigital type. For the vesicular types, occurring on the plantar surface, Byam and Archibald advise as follows:

"*Keep the patient at rest in bed, and apply dressings of perchloride of mercury lotion (1 in 4,000) continuously. Later, a lotion of Liquoris Plumbi Subacetatis 2 drams, Aquae Destillatae add 10 ozs. (300 c.c.), and finally a dermatol dusting powder.*

"*If the eruption is developed upon fungal lesions, treat as above, and, when the acute symptoms have disappeared, institute an antimycotic therapy by means of silver nitrate 3–5 per cent.*"

(15) In the Journal of the American Medical Association, dated April 18, 1931, William L. Gould, M.D., in an article entitled "*Ringworm of the feet,*" recommended sodium thiosulphate solution in various strengths; stating that a solution as low as 3% was found efficient, but advising the use of a 10% to 15% solution both as a curative and prophylactic treatment to be used in such places as gymnasiums and swimming pools. He also advised that, instead of the solution, a powder for light dusting of the feet can be prepared by using 20 per cent. powder of sodium thiosulphate in boric acid. This may be applied to feet, footwear, and floors as a prophylaxis.

(16) It has been reported that x-rays have yielded good therapeutic results.

(17) Most satisfactory results have been obtained in severe cases, by keeping water and soap away from the feet; and cleansing them with olive oil twice a day and applying ointments, as indicated, between the oil baths.

(18) Diet. There is no doubt but that quicker results are obtained with the local treatments, if sugar and the so-called acid-ash carbohydrates are eliminated in the diet—i.e., eliminate the di-saccharides entirely, and increase the root starches at the expense of rice, cereals and bread.

(19) Another most important factor is the careful drying of the feet after the bath—most especially between the toes—after which talcum powder should be applied. An equally important factor is the absolute cleanliness of the footwear and of the bath, in order to avoid reinfection and as a prophylactic measure for others.

PARTIAL ACHONDROPLASIA—CASE REPORT

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Achondroplasia is a disease which affects especially the growth of the long bones and the base of the skull. Its most conspicuous clinical features are; nanism, due to the shortness of the extremities and especially of their proximal segments; a large head; an unusually deep depression of the root of the nose; and trident-shaped hands.

However, cases of partial achondroplasia have been reported and, in these, one or more of the typical clinical features may be missing. Under this latter classification, I place the case which is reported and illustrated below:

History.—O. H., 16 years of age, native of Honduras, entered the hospital November 26, 1931, in labor; and, the following day, successfully delivered a normal female child weighing five and one-half pounds. This was her first pregnancy. The patient stated that her hands and feet were weak and, though she had always enjoyed excellent health, she had been unable to walk before the age of twelve years. She had been told that the abnormality of hands and feet had existed since birth.

Family History.—The patient has no recollection of her father. The mother is normal in size and form. Five brothers and sisters are normal in body and limbs.

Physical Examination.—The physical examination on Dec. 8, 1931, showed a young and not uncomely native girl, with intelligence which conformed with her education and social status. Her height was 59 inches; and weight, 118½ lbs. The head was well formed, and covered with an abundance of glossy black hair. The largest circumference of the head was 21½ inches; and there were no unusual protuberances. The nose was well formed; and was not unusually deep at the root nor broad at the nostrils, in proportion. The palatal arch was broad, well formed, and low. The upper teeth were even and regular; but there was angulation and crowding of the lower incisors. The ears and eyes were normal. There was no apparent enlargement of the thyroid. The neck measured 11½ inches.

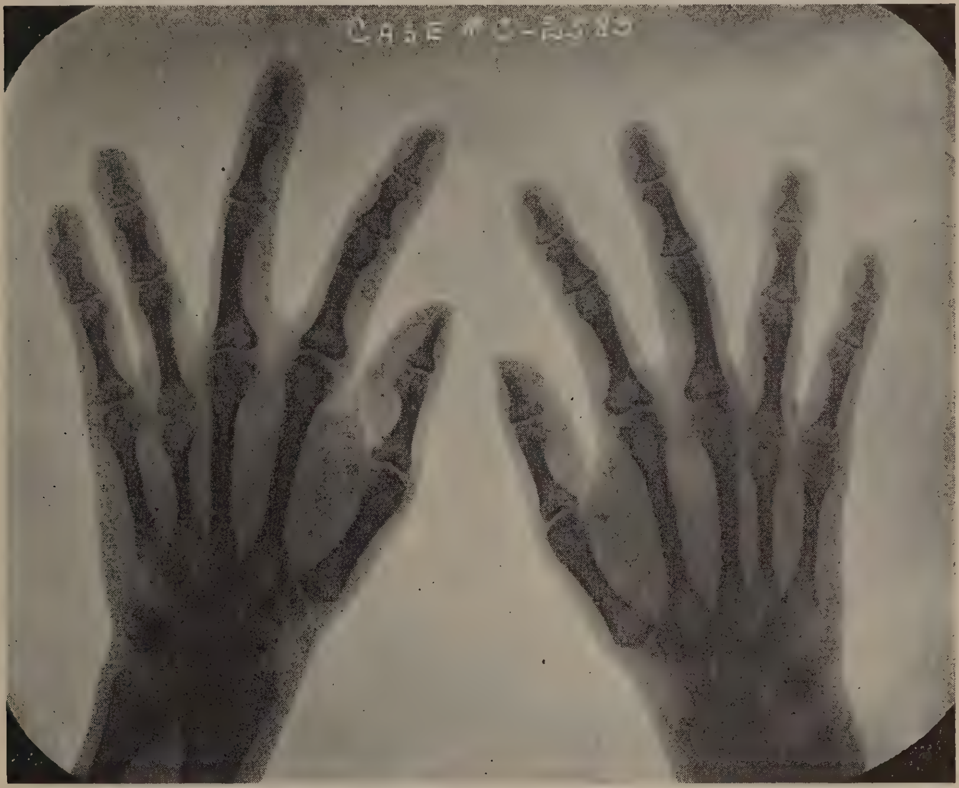

PLATE 1

The chest measured 30½ inches, under arms, with no enlargement of the costochondral nor chondrosternal junctions. The heart and lungs were normal.

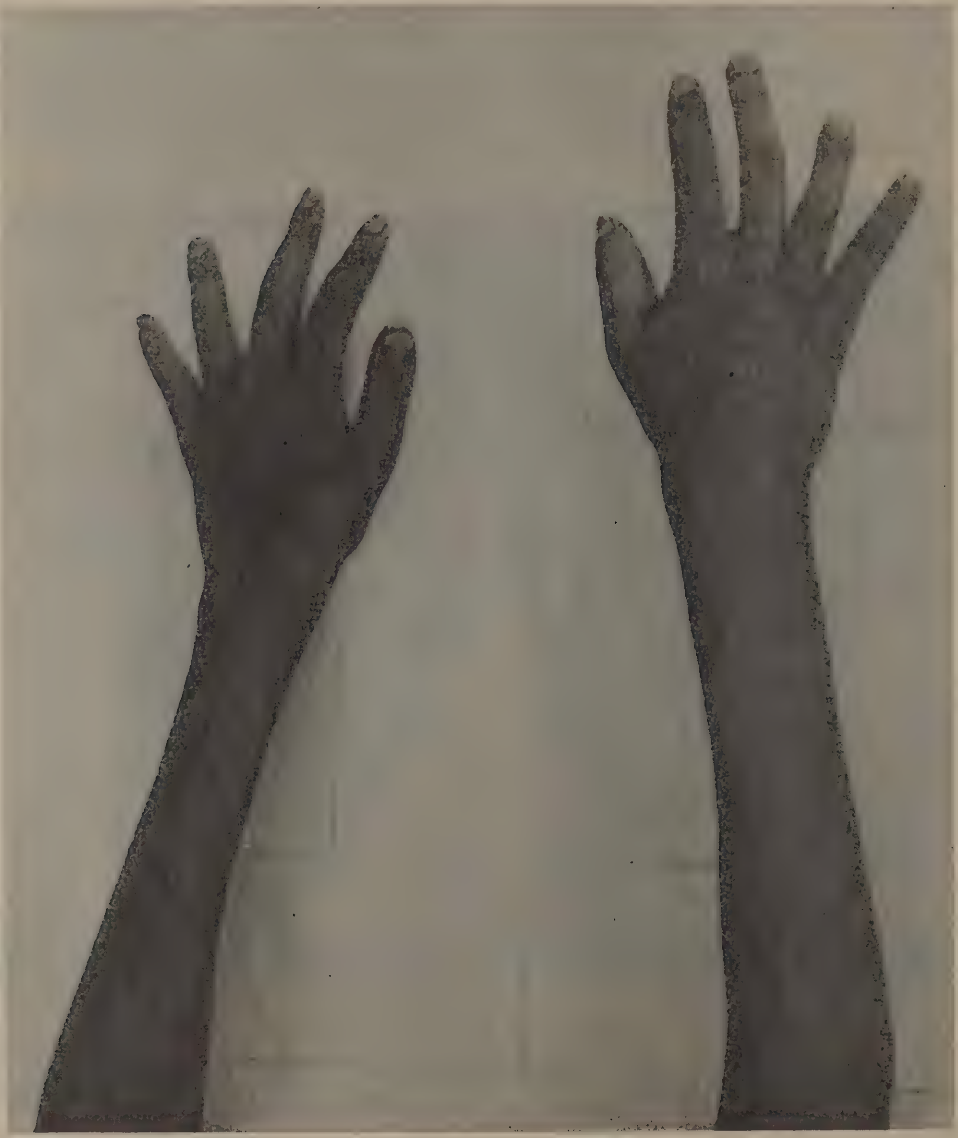

PLATE 2

The length of the left ulna was 9 inches; and of the humerus, 12 inches. Motion in the shoulder joint appeared to be normal; but the elbow joints could be hyper-extended. The forearms were rather small. The wrist joint was markedly relaxed; and the whole hand could be easily hyper-extended to lie upon the forearm. The encircling finger easily drew the palm and fingers of either hand into a cylindrical shape. Gripping strength in the hands was about equal to that of a lusty year-old baby.

The condition of the hands is shown in Plates #1 and #2.

The abdomen was a normal parous one, measuring 28½ inches at the umbilicus. The abdominal organs and pelvis appeared normal. The sex organs were well developed, with a normal growth of pubic hair.

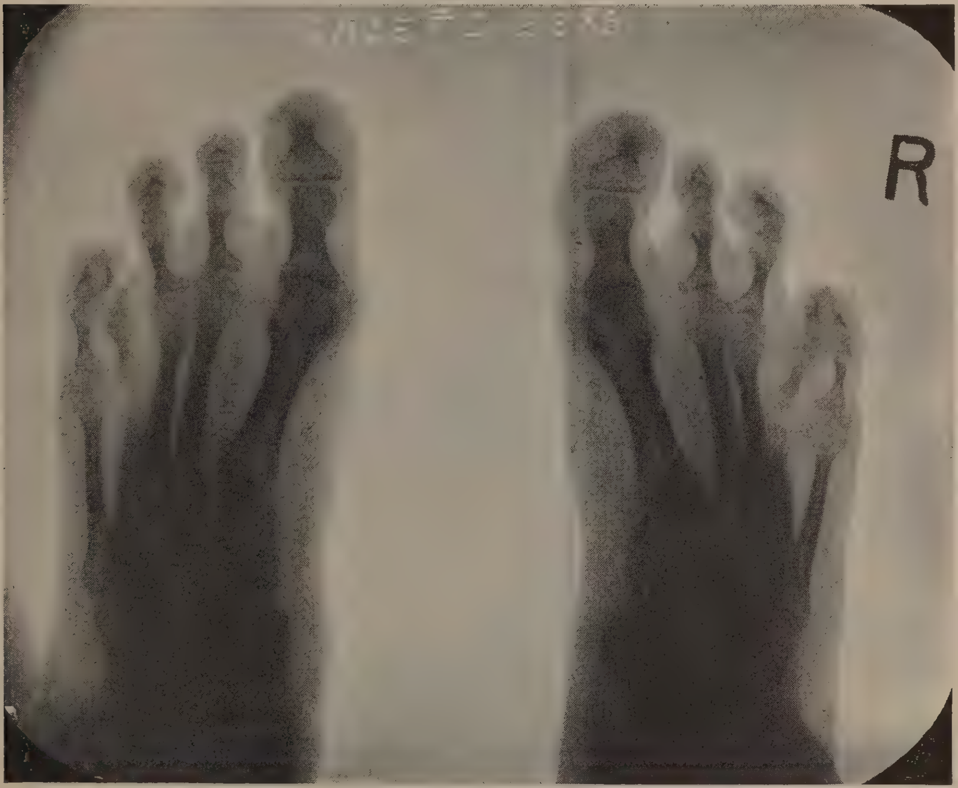

PLATE 3

The hip and knee joints were abnormally mobile; so much so that the patient could stand erect without support only by tilting the pelvis to one side or the other, thus throwing the weight on to one leg and using the other for a brace. The gait was shuffling; and the patient was unable to lift either foot more than 6 inches from the floor, without using some support.

The ankle joints were markedly weak and relaxed, with pes planus of third degree. The arrangement of the toes is shown in plates #3 and #4, the 4th toe lying in a higher plane than the others of the same foot.

The thoracic back was very flat and smooth; no sign of scapulae or vertebrae being seen when the patient assumed the erect posture. However, there appeared to be no kyphosis or lordosis of any part of the column, nor any signs of a hidden spina bifida.

On admission, the Meinicke flocculation test was negative; the blood was negative for malaria; the stool showed ova of ascaris and uncinaria. On December 8th, the white blood cells were 8,800; red blood cells numbered 2,000,000; hemoglobin was 80%; differential: small lymphocytes 43%, large lymphocytes 1%, polymorphonuclears 34%, eosinophiles 20% and basophiles 2%. On this same date, the photographs and x-rays were made.

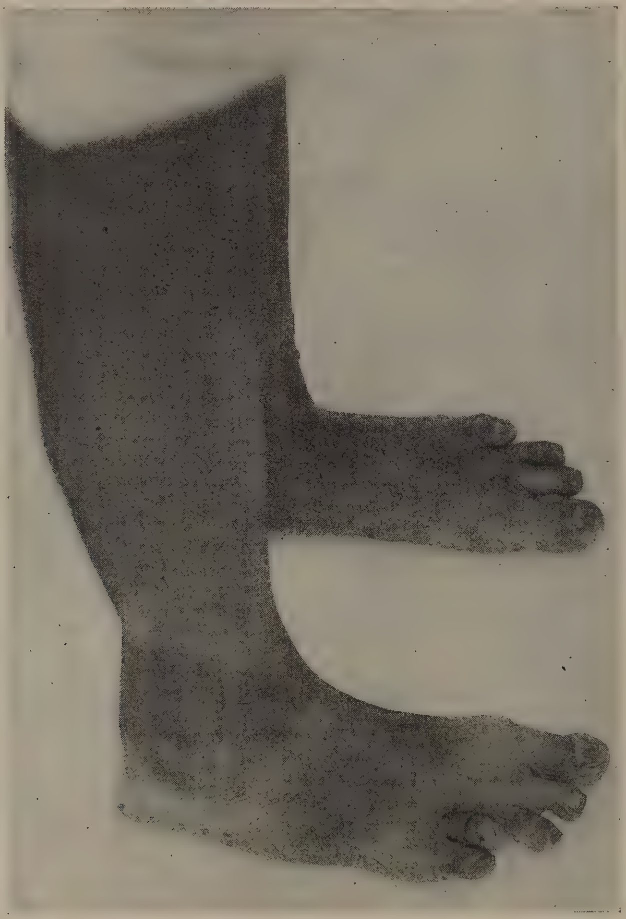

PLATE No. 4

SUMMARY

The case of a young girl showing the flat thoracic back, the trident-shaped, relaxed hands, the deformed feet with genu valgum, and relaxed hip joints; but lacking the other characteristics of true adult achondroplasia, is reported. This case is classified as a partial achondroplasia.

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A CASE OF TRANSPOSITION OF VISCERA

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The patient, a female, colored Jamaican, 42 years of age, was admitted to the Hospital on December 4th, 1930, to undergo an operation for fibromyoma of the uterus. Otherwise, she was in good health.

On examination, her heart sounds were normal; and nothing was noted to indicate the peculiar condition discovered at operation and confirmed later by fluoroscopic examination.

At the time of the operation, after removing a very large fibromyomatous uterus, the abdominal organs were inspected for notation on the operating sheet and found to be transposed. The appendix was on the left and the sigmoid on the right. The liver and spleen, and likewise the position of the stomach, were transposed also. After operation, a careful examination revealed a dextrocardia. The patient was discharged on the twelfth day.

She returned two weeks later to have a fluoroscopic examination of her chest and gastro-intestinal tract. This confirmed our former findings—particularly in reference to the heart and the course of the duodenum.

This is the second patient that has come to our attention this year with a known dextro-cardia. The first case did not have a gastro-intestinal fluoroscopic examination to determine whether or not there were any further transpositions.

CHEILITIS GLANDULARIS—CASE REPORT

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Cheilitis glandularis is a rare disease of the lower lip, characterized by adenomatous changes in the labial mucous glands, dilatation and hypertrophy of the ducts, and, subsequently, a chronic inflammation of the labial tissue.

To Volkmann[1] is attributed the first report of this condition. His cases were characterized by a chronic inflammation of the lower lip, especially of the vermilion part; but occasionally the inflammation extended to the buccal mucous membrane and adjacent skin. Purdon[2] noticed a case in which the upper lip and the mucous membrane of the mouth were also involved.

Fox[3] and Schamberg[4] have reported some cases occurring in the United States. Russell[5] reported a typical case. He attributed the condition to the stomatitis caused by the injudicious use of mercury by a syphilitic patient. Sutton's[6] histological studies show it to be an adenomatous condition of the mucous glands, causing an increase in the glandular tissue and enormous dilatation of the ducts. It is considered a disease of early adult or middle life. The etiology is unknown.

CASE REPORT

V. H., Guatemalan, male, 26 years of age, married, came to the hospital seeking relief for a persistent inflammation of the lower lip. Past and family histories were essentially negative.

History of present illness.—Seven years ago, the patient noticed that his lower lip seemed to have increased in size. He could also see, with the aid of a mirror, droplets of saliva upon the vermilion part of the lip; and observed that, as soon as he would wipe these droplets, new ones would immediately appear. He had visited several clinics in the United States and Mexico, but did not obtain relief; instead, the lip continued to increase in size, and the secretion in those openings near the angle of the mouth changed from that of pure mucus to a mucopurulent one. During the past few years, the inflammatory condition had remained stationary, although the secretion seemed to have increased in quantity. The patient admitted that he was despondent, due to the belief that he had an annoying and incurable disease; but stated that he had come for treatment in the hope that some method of alleviation of his condition had been discovered during the past year.

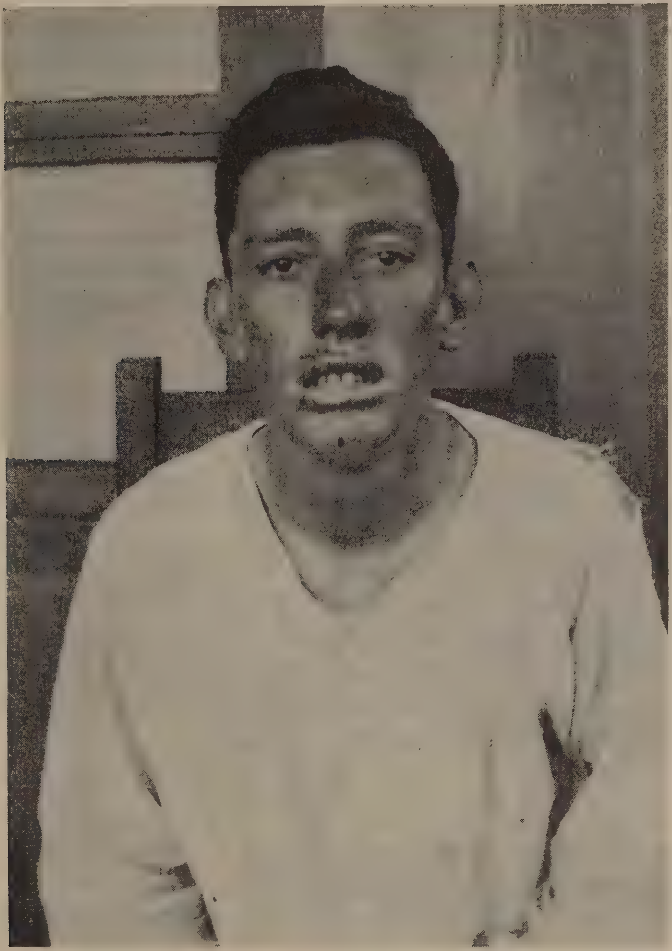
Physical examination.—The patient's general appearance was healthy, and the general physical examination was negative. The lower lip was about four times the size of a normal one, and showed the typical characteristics of chronic inflammation. The vermilion area was prominently displayed in a manner that may be described as ectropion of the lower lip, and was deep red in color. On the portion normally corresponding to the dental surface, there were two rows of papillary elevations, lying approximately parallel to each other, from which there was a continuous flow of mucus. The secretion from the largest papillae, near the angle of the mouth, was mucopurulent in character with a tendency to crust formation. The contiguous skin was erythematous; but the buccal mucous membrane appeared normal. The upper lip was inflamed and slightly increased in size, but neither papillae nor mucous oozing could be detected.

A fine probe could be inserted to the depth of one-half inch into many of the openings in the lower lip. The mobility of the lip was greatly impaired; and the consistency, on palpation, was hard and firm. Large drops appeared at the openings of most of the ducts, on applying pressure; and from the largest ones an amount of fluid would be ejected. Pain could be elicited on firm pressure. The regional lymph glands were not palpable.

Laboratory report.—Erythrocytes, 4,300,000; leucocytes, 6,500; hemoglobin, 85%; Meinicke blood test, negative; stool, negative; urine, negative.

Treatment.—For five weeks, tonics and potassium iodide were given. Silver nitrate and zinc oxide ointment were used locally. No improvement was noted, except a decrease in the inflammation of the upper lip. The secretion seemed to increase in amount under this method of treatment.

After an interval of about one week without treatment, twelve of the larger glands were desiccated with an electric needle (Russell's method), under local anesthesia. The immediate inflammatory reaction from the treatment caused the lip to become even more tensely swollen; but this subsided in a few hours. Twelve days later, all but three of the glands treated were closed and dry. The remaining glands were then carefully desiccated, with complete success. The sudden decrease in the size of the lip and the subsidence of inflammation was remarkable. The patient was elated, when he found that he was free from the constant mucous and mucopurulent discharge; could approximate his lips; and could take liquids without tilting the head backwards, as he had had to do previously. The lip was much softer and more resilient, and the mobility was rapidly approaching normal. Stimulation of the orbicularis oris muscle was not found necessary.



The patient was discharged as cured, and promised to return in case of any recurrence of his trouble. He has not returned, up to this time, and it is presumed that the cure was permanent and complete.

COMMENTS

In all probability, the increased secretion observed in the disease is directly due to the proliferation of the active secretory cells of the glands; and the subsequent inflammation can be attributed to the entrance of pyogenic bacteria into the widely opened ducts, plus the irritation caused by the constant use of a handkerchief in removing the secretion. The inflammation causes an eversion of the lip; and this is explained by the loose anatomical structure of the mucous surface of the lip, permitting large quantities of lymph and inflammatory exudate to collect in the soft tissues and to roll them out over the more resilient skin surface. The discharge of the secretion, therefore, flows outward; instead of into the buccal cavity, as in normal individuals. This discharge is usually of a mucous character; but in those cases of long standing, in which pyogenic organism have obtained an entrance into the open ducts, a mucopurulent or even a purulent discharge is observed. The inflammation of the upper lip could be attributed to the constant irritation caused by the use of a handkerchief; and also ascribed to the necessity of keeping the mouth opened, since it was impossible to approximate the lips.

CONCLUSIONS

1. Cheilitis glandularis is a rare disease, of unknown etiology, affecting the lower lip.
2. Any ordinary local or general treatment is of no value in bringing about a cure.
3. The mental effect of this disease on the patient is extremely depressing; but these symptoms are entirely relieved by effecting a cure of the condition.
4. Inflammation is presumed to be due to the irritating effect of constant wiping, and of the invasion of the gland ducts by pyogenic bacteria.
5. A prompt and persistent cure is produced by the total destruction of the glands and ducts, preferably by electric desiccation.

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TROPICAL IMPETIGO—A CASE REPORT

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The only interesting features to be presented in this case are (a) its rather unusual severity and (b) its extremely low tolerance for mercury.

Case No. 26926, a mulatto woman, aged 31, well developed and nourished, entered the hospital with an extensive eruption covering the legs, thighs and abdomen. The condition began on the upper and inner aspect of one of the thighs, about a month before admission, as small blebs. These blebs broke and spread to other parts; as the lesions are quite autoinoculable in children, and even in adults.

Physical examination.—Many of the early lesions of tropical impetigo were found. These consisted of the typical small erythemic macules, which soon develop into small, irregularly-sized vesicles or blebs unsurrounded by zones of inflammation. Upon rupture of the vesicles, erythemic areas remain which resemble first degree burns. A secondary pus infection had complicated some of the lesions; and this infection was responsible for the temperature of 102.5°F., which she had on admission. There were no enlargements of the lymphatic glands; ears, eyes, nose, mouth and throat were negative; heart and lungs were negative; abdomen was slightly tender over epigastrium; liver and spleen were negative; reflexes were normal.

Laboratory examination.—Urine, albumen, very faint trace; sugar, negative; sediment, a few hyaline casts; stool, uncinaria and trichocephalus dispar; blood, the Meinicke test was negative and thick film was negative for malaria; hemoglobin, 65%; white blood count, 16,000.

After the completion of the examination, she was given a warm sponge bath, in bed, with 1/5000 bichloride solution. Thereafter, the lesions were treated with 2% mercurochrome solution—220 soluble. After these had dried, 5% ammoniated mercury ointment was applied to each lesion.

The morning of the second day, the lesions showed remarkable improvement; and the temperature had subsided, and remained normal. The treatment outlined above was repeated.

On the third day, unfortunately, we found the patient suffering intensely from severe ptyalism. Most of her teeth had loosened and she could hardly swallow. Two injections of sodium thiosulphate were administered, and gave some relief; but the recovery from the salivation was slow and protracted. Needless to say, the case was distinctly one in which the cure was far worse than the disease.

GONOCOCCAL ARTHRITIS—WITH CASE REPORT

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Gonococcal infection usually begins with an acute urethritis. It may also start as a conjunctivitis, vaginitis, or, more rarely, as a proctitis or a stomatitis. This primary stage may subside, become cured, or run a chronic course; or else a secondary stage may be initiated in which, thru continuity of tissues, there is a spread of the infection, producing a cystitis, prostatitis, seminal vesiculitis, or epididymitis in the male, or a cystitis, endometritis, salpingitis, ovaritis, parametritis, or pelvic peritonitis in the female. After an early acute attack, the disease is a potential source of a generalized infection. Such a condition might be called a third stage. When the blood stream is involved, the organism may be transported to remote parts of the body and there set up secondary focal lesions. Pathologically, it resembles other coccal infections; but differs in being milder and rarely causing death, and in the tendency of the lesions to heal themselves without drainage.

There is a predilection for joint localization, tho other organs are occasionally involved.

Two types of gonorrheal arthritis are recognized: (1) Acute gonorrheal arthritis—(a) sero-fibrinous, and (b) phlegmonous; and (2) Chronic gonorrheal arthritis—(a) hydrops, and (b) ankylosing form. The sero-fibrinous form is the most common of all forms. The phlegmonous form is usually due to a mixed infection and is more rarely encountered. Chronic hydrops begins very insidiously and causes little pain. It may follow the acute forms. The ankylosing form simulates other infectious deforming arthritis, and is very common.

The case reported below is of the sero-fibrinous variety.

Case Report

R. A., age 21 years, white male, born in British Honduras, came to the clinic complaining of an acute pain in several joints, which had begun insidiously four days previously.

History.—He had had the usual childhood diseases; but otherwise had enjoyed fairly good health except for occasional colds. He had had a gonorrheal infection one month previous to the onset of his present complaint. He had followed treatment at the clinic; and the discharge, which was never very profuse, had practically ceased, and only a morning drop persisted. Four days ago he noticed pain in his right ankle, right wrist and left knee joints. The pain became intolerable and some inflammation became manifest in his right wrist and left knee joint.

Physical Examination.—Digestive, respiratory and circulatory systems were negative. The inguinal glands were palpable. No urethral discharge was noted. His right ankle, right wrist, and left knee joints were very tender. Swelling was noticeable particularly in his right wrist joint.

Laboratory Examination.—Prostatic fluid smears showed the presence of gonococcus plus. Urine: albumin, slight trace; sugar, negative; a few blood and epithelial cells, and mucus threads, present. Meinicke flocculation test: negative. Leucocyte count: 12,500.

Progress and Treatment.—On admission, the temperature was 101 degrees F., and the pain was very marked. Sodium salicylate, grs. 15 every two hours, was administered after a preliminary saline purge. The next day, there was no relief from the pain. Salicylates, and the local use of heat and cold, gave no relief. Boiled sterile milk (10 cc.) was administered intramuscularly, to produce protein shock. The reaction was very good. The temperature arose to 103 degrees F., pulse 108, respiration 30. That night the pain was so intense that $\frac{1}{4}$ gr. morphine was administered hypodermically. A ten-minute therapeutic light bath was given twice daily.

Four days after the first milk injection, another was given; and a similar febrile reaction was obtained, although the accompanying pain was much less and the temperature was 99 degrees F. at its highest peak. The initial arthritis of the other joints subsided, and only the left knee joint remained swollen and tender.

On the fourteenth day of the disease, another milk injection was administered. The knee joint became very painful; and the next day an aspiration was done, removing 120 cc. of sero-fibrinous, amber-colored fluid. It was free from gonococci. After the aspiration, the swelling subsided rapidly and did not reappear again. The patient was carried outside in a wheel chair for daily sun baths. He was discharged on the 23rd day of the disease, resuming his previous work one week after discharge. The patient was advised to continue local treatment of the urethritis.

CONCLUSIONS

A case of gonorrheal arthritis of the acute sero-fibrinous form, terminating by resolution and treated by protein shock therapy, is reported. Points to be noted in this case are: 1. Gradual onset. 2. Involvement of several joints, with final involvement and localization in a single one. 3. The lack of response to salicylates. 4. The inability to find the gonococcus in the exudate; which is inconclusive, since it is frequently impossible to find the organism when fluid is aspirated shortly after the onset of the effusion. 5. The good results obtained thru the use of protein shock therapy; and the absence of sensitiveness to the protein used.

A CASE OF YAWS

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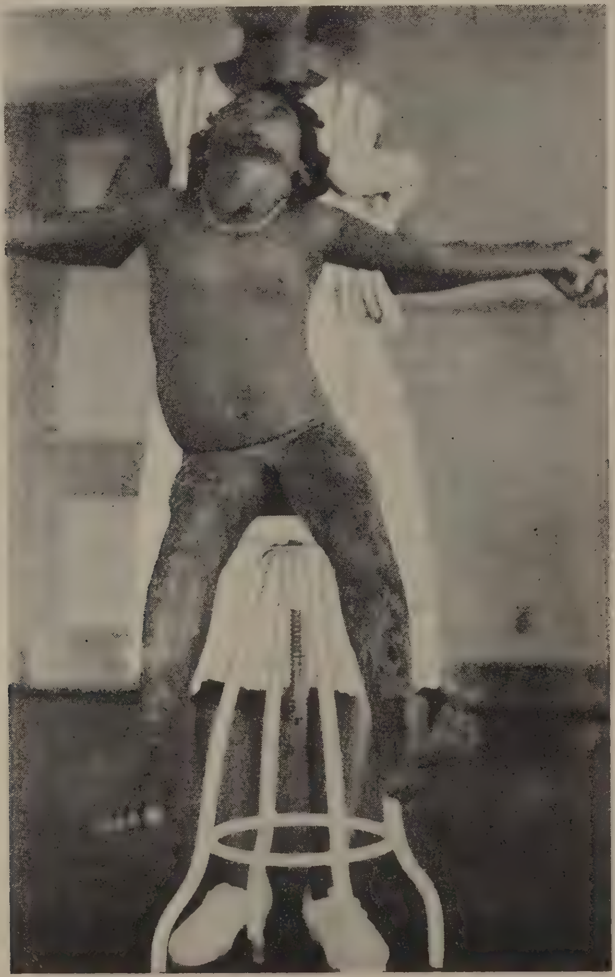
Puerto Armuelles, R. of P.

Yaws is not a very prevalent disease on the Pacific Coast of Panama and Central America; although, in the year of 1926, an epidemic of yaws appeared in Canton de Osa, a small village situated in Costa Rica near the boundary line of the Republic of Panama. This town is about 30 miles from our Hospital. More than 40 cases were reported at that time.

The case I am reporting is the third one that has come under our observation since the Hospital was opened three years ago. The patient is the third member of the native family that has become contaminated.

A female, eight years old, was brought to the clinic on October 10th, 1931, by her mother. The mother stated that the child had been suffering from this "ugly skin disease" for the past five months. She said also that, in 1929, she had brought to the clinic her older child, 13 years of age, suffering with the same condition; and that, in the latter part of 1930, her younger boy, 3 years of age, had also been infected with the same disease. Hospital records show that her statements are correct; and that two of her children were treated previously for yaws.



The accompanying illustration shows the disease in its generalized stage. Numerous papules and tubercles are located about the face, neck and legs, and the perineal region. The lesions were extra-genital, and there were no lymphatic enlargements. The child complained of painful legs, and itching on the anterior aspects of the legs where there was some secondary infection of the papules.

Dark field examination of serum obtained from the papules and tubercles revealed the presence of numerous Treponemata pertenue. Her skin lesions cleared up entirely after four intramuscular injections of myosalvarsan, of 0.4 gm. each, given at intervals of 5 days.

This case illustrates the facility with which the native children; who go bare footed and naked, and live under unsanitary conditions; become contaminated by the virus of yaws—probably by simple contact.

REPORT OF ACQUIRED SENSITIVITY TO ERGOT

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An American, age 33 years, was admitted in labor on December 15, 1930, and had a normal delivery. After delivery of the placenta and membranes, she was given fluid extract of ergot dr. 1 as a precaution against relaxation of the uterus. Within a few minutes, she complained of a severe pain in the back between the shoulders. This was thought to be some muscular strain during labor, and she was massaged by the nurse. Two hours later, a follow-up dose of ergot was given; and, by this time, the pain appeared to be at the base of the neck.

It has been our custom to give ergot routinely after labor; because of the slight anemia that white women experience in the tropics, which is usually accompanied by an atonic and slightly asthenic state. We conclude that the result of this routine procedure is better involution and a lessened tendency to ascending infection through the uterine lymphatics. Accordingly, the patient was put on fluid extract of ergot dr. 1 t.i.d., which we usually continue until a purge of castor oil is given on the third day after delivery.

The first day, the patient experienced a slight headache, with a continuation of the pain in the back and neck. As the pulse was 72 to 76 per minute, and there was no fever or other untoward symptoms, the backache and headache was attributed to labor and to nervousness. On the second day, the pain grew worse; and the usual remedies were tried to relieve the pain. Bromides, phenacetin, and aspirin failed to give results. By nightfall, the pain had increased to a cerebral pounding, which was more pronounced in the occiput. By this time, a total of eight drams of ergot had been administered.

The pain became unbearable to the patient, who was tossing about and apparently in a very nervous state. It was at this point that a tentative diagnosis of the condition was made. It was realized that the condition must be attributed to external causes; as the patient had been carefully observed, there was no fever nor increase in the pulse rate, and the urine was plentiful and free from albumin and casts. Ergot was the only drug that had been given throughout the period, and the possibility of its toxic effects were considered. Our suspicions were confirmed by finding a slow pulse of 60 per minute, and a blood pressure of 160 systolic and 130 diastolic. The blood pressure before delivery had been 96 systolic.

At 10:30 p.m., a hypodermic injection of gr. 1/4 codeine sulphate and gr. 1/100 nitroglycerin was given. The patient felt the effects rapidly, and had mild shock with dilated pupils and profuse perspiration; and the blood pressure dropped to 90 systolic. At 10:45 p.m. the pressure had returned to 120 systolic, and at 12:00 midnight was 160 again. At 12:20 a.m., grs. 5 sodium nitrite were given by mouth; and at 12:35 a.m. the pressure was 130, with pulse 78 per minute. The throbbing pain began to disappear, and at 1:00 a.m. the pressure remained at 130.

Regular doses of grs. 5 of sodium nitrite proved too large, and gave syncope-like disturbances; so that it was reduced to grs. 2 every two hours, and later to every four hours for five days. During these five days, the blood pressure remained high, and once reached 180; but it was controlled after each dose of sodium nitrite. Gradually the pressure came down; and, twenty days after delivery, it was only 100. The patient felt well, except when the blood pressure was high. The urine remained normal. The appetite was good; and no symptoms remained except general weakness and a sensation of heaviness in the occipital region. Lactation was normal.

Past History.—The patient had a normal delivery in 1926, and did not receive ergot after labor. In 1928, she had a second normal delivery; and felt much better during the puerperium and succeeding months than after the first child. After this second delivery, ergot was administered during the three succeeding days.

In June, 1929, after having an amenorrhoea for two months but without the usual subjective symptoms of pregnancy, she took a long automobile trip and began to flow. This soon increased; and, after cramping pains, she delivered what proved to be a hydatidiform mole. During the treatment she experienced the same sensations, shock, air hunger, restlessness, and apprehension as during the present trouble. This, she thought, was due to hemorrhage. For several months afterward she also had the aching and heaviness in the occipital region. On investigation, it was found that ergot was administered at that time.

Discussion.—The patient evidently took ergot without any reaction during her second delivery. There was a reaction similar to the third delivery, at the time of passing the hydatidiform mole. Had the patient acquired a sensitivity to the drug from its first administration?

We are told that ergot will increase the blood pressure by constricting the arterial system. Is this vaso-constriction action sustained for a long period after the administration of the drug is stopped and sufficient time has elapsed to allow for its elimination? It appears in this case that the long-sustained action was rather a paralysis of the vasodilators with the normal or stimulated action of the vasoconstrictors coming into play, as otherwise the blood pressure should have dropped as soon as the drug was eliminated. Perhaps elimination is slow, due to some "fixing" of the drug in the tissues.

The literature on the subject is very limited; except where poisonous doses have been taken and have resulted fatally, with gangrene of the extremities, etc.

As the real action of this drug is not fully known, it was thought timely to report this unusual idiosyncrasy or sensitivity to the drug.

REPORT OF A CASE OF ALEUKEMIC MYELOGENOUS LEUKEMIA, WITH AUTOPSY DIAGNOSIS

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Panama, R. P.

CLINICAL HISTORY AND FINDINGS

The patient was 56 years old; Irish by birth, but a naturalized American citizen. He was apparently in good health when he was first seen.

He had been a mariner all of his adult life; and was, at the time that he was afflicted, on active duty as a Captain of a steamship. He was married. His wife had been in a Sanatorium for the past twelve years with mental trouble. His only children are two daughters who are living and well.

He had the ordinary diseases of childhood with a Neisserian infection in youth. There was no history of luetic infection.

In 1928, an appendectomy was done at the University of California Hospital. Except for this, he has always been healthy and active until the present trouble began.

In July, 1931, he had two teeth extracted and he believed that his present trouble began shortly after this. About September 25, 1931, he noticed a tingling and numbness of the chin and lower lip.

On September 28th, he had two more teeth extracted in New York City. These were taken from the lower left jaw; and, at the time, the dentist told him that the rest of his teeth were bad. About October 1, 1931, while enroute from New York to Cristobal, he suddenly discovered that he had diplopia which was much more marked when he tried to look to the right. At the same time, pain developed at the site of the extraction of the teeth; and the paresthesia of the chin became more pronounced, and noticeable on both sides.

He was admitted to the Hospital de Panama on October 4, 1931. Dr. D. F.

Reeder reported that there was a paralysis of the left external rectus muscle. The ocular fundi were normal. A granulation tissue had formed small tumors in the sockets of the extracted teeth. The tonsils were enlarged, cryptic, and slightly inflamed; although he did not complain of any sore throat, and no ulcers were present. There were only two teeth remaining in the lower jaw, and only the incisors and premolars in the upper jaw; and all of these were in bad condition.

The patient was examined by Dr. C. D. Briscoe, Dr. T. G. Guardia and myself. He was apparently in good health and complained only of the diplopia, and the paresthesia in the chin, with some pain at the site of the extractions. He was normal mentally, alert, and not self-conscious. The pupils reacted to light and accommodation, and the deep and superficial reflexes were normal. The thyroid gland was normal. No enlargement of the superficial lymph glands was found. The heart was normal in shape and size, with regular rhythm and good tones. There was a slight fibrosis of the peripheral arteries. The blood pressure was 160–140/80, and the systolic pressure was not well sustained. The liver and spleen were not enlarged, either on palpation or percussion. Later the liver became palpable, but at no time during his illness could the spleen be felt. There were no masses or tenderness in the abdomen. The lower extremities were normal. The urine contained a faint trace of albumen and a few casts on various examinations.

On October 26th, the patient was examined by Major Sydney L. Chappell, the neurologist detailed for duty in the Canal Zone by the United States Army, and the consulting neurologist to the Herrick Clinic and Panama Hospital. Dr. Chappell saw the patient on October 26th, November 1st and November 6th. A summary of his reports is given later.

The Wassermann test for the blood and the spinal fluid was negative, and the blood chemistry was normal.

The patient was under observation from his admission on October 4th until his death on November 7th.

At first there was a very slight irregular fever, never going above 99.5° or 100°, for about a week. This was followed by an afebrile period until November 1st. On November 5th, there was a rise to 100.5°; and on November 6th there was no fever. On November 7th there was a febrile rise to 103°, followed by a drop to 99.5° in the afternoon, and an axillary temperature of 101.5° just before death.

On October 16th, Dr. J. J. Vallarino reported that the roentgenological examination of the lower jaw showed a periostitis. Between this date and October 26th, Dr. Vallarino made several other examinations. On October 26th, Dr. Vallarino made a further examination, including the jaw, head, thorax and cervical spine. With some difficulty, a satisfactory view of the left jaw was obtained. Dr. Vallarino reported that destructive changes predominated in the jaw, and were spreading. The process started around the region of the left lower first bicuspid, and apparently had spread back to the angle of the jaw. Nothing of importance was found in the other examinations; and the mediastinum and chest were clear.

On October 6th, a routine blood count had been made which showed 6,000 leukocytes with a normal differential. On October 26th, the technician reported that she had found normoblasts. A special examination was then made by Dr. James, and a myelogenic leukemic blood picture was found. The details of this and other counts are given later.

On October 27th, the leukocytes were 6,000, the erythrocytes 2,830,000, and the hemoglobin 55%. Between October 26th and November 7th, leukocyte counts were made almost daily and several more erythrocyte counts were made. The leukocytes varied between 6,000 and 8,000; and the erythrocytes remained about the same, as did the hemoglobin.

Due to the roentgenological findings in the jaw, and the blood picture, a malignancy was suspected, with metastases to the bone marrow. The condition of the patient was out of all proportion to the physical findings; and he grew steadily worse.

A myelogenous leukemia of the aleukemic type was strongly suspected also; but was not considered as demonstrated, as will be explained later.

The patient complained of increasing weakness. He developed severe pain across the back, in the hips and in the lower extremities. He complained of burning in the eyes, but his mentality remained clear until a few days before the end. Attempts were made to obtain roentgenograms of the long bones of the lower extremities, but the results were not satisfactory.

On the 23rd of October, a slight swelling was noted on the right side of the neck just above the clavicle. The skin was movable over the swelling, which was thought to be in the thyroid gland. This swelling increased very rapidly, so that on the morning of October 26th it appeared as a large tumor mass apparently involving the right lobe of the thyroid. After October 26th, it increased only very slightly in size; and this was the only glandular enlargement which was noted during the course of the illness, although careful examinations were made daily. On the morning of October 26th, a paralysis of the right external rectus appeared.

Dr. Chappell made a very complete neurological examination on this date, an abstract of which is attached. About this time the patient began to complain very much of pain in his teeth; and, on November 2nd, Dr. Reeder removed the remaining teeth in the lower jaw. He also removed some of the granulation tissue which had formed after the previous extractions. Imprint smears were made from this, and the tissue sent to the pathologist, Dr. G. F. Clark, Medical Corps, U. S. N., who had been kind enough to do our pathologic work during the absence of Dr. Lawrence Getz, our Chief of Laboratory. The tissues were fixed in Zenker formol and formalin. Dr. Clark reported that the sections showed a very marked round cell infiltration with many red blood cells scattered throughout the tissue, suggestive of a leukemic process. The sections were also examined by Dr. Dart, who gave a similar opinion.

The patient was again examined by Dr. Chappell, on November 1st; when he found no change in the neurological status, but a very marked change for the worse in his physical and mental reactions.

He was again examined by Dr. Chappell on November 6th, and an abstract of Dr. Chappell's report is given further on.

From October 26th to November 7th, the patient gradually sank. He complained of severe pain in the jaw, and also sharp shooting pains in the eyes, across the back, and in the lower extremities. For the last two or three days of his life his mental reactions were very sluggish; although he replied adequately, when pressed. On the evening of the 6th, he passed into coma; and died about 9 p.m. on the 7th.

The clinical diagnosis was malignancy of undetermined origin, probably originating in the left lower mandible, with metastases.

Notwithstanding the very frequent examinations which were made, the only positive objective findings were the blood picture, the granulation tissue in the teeth sockets, the tumor of the thyroid, the double external rectus paralysis, and an enlargement of the liver which appeared late. As stated above, at no time was the spleen palpable nor were any of the peripheral glands enlarged except the thyroid.

CLINICAL REPORT CONTINUED

In this report the term *leukemia* is used to denote that type of the disease in which there is a definite leukocytosis, accompanied by marked qualitative alteration in the white cells of the peripheral blood. *Aleukemia* is used to designate this qualitative alteration, but without leukocytosis. Personally I prefer Piney's (1a) use of the term *leucosis* to designate all hyperplasias of lymphatic or myeloid tissue, with *lymphadenosis* for the former, and *myelosis* for the latter. But the terms *leukemia* and *aleukemia* seem at this time to have an established place in hematological, clinical, and pathological nomenclature; and are therefore used in this case report.

The detailed differential blood counts which follow are not, in my opinion, suggestive of a true leukemic process. Allowing for the usual errors in blood counting, the total number of leukocytes was fairly constant during observation at about 7,000. This does not rule out a true leukemia, since during remissions the count may fall to normal, or it may do so as a terminal incident. But the date of onset of the disease appears to be fixed around September 25th, as there was no formation of granulation tissue in the sockets of the extractions of July, and the counts between October 6th and November 7th show no leukocytosis. Dr. Dart suggests in his report that the low leukocyte counts may represent a temporary reduction, such as occurs in all forms of leukemia, but the evidence seems to be against this. Remissions, characterized by reductions in the leukocyte counts, whether occurring spontaneously or as a result of treatment, are seen almost always only in the subacute and chronic leukemias. These show unmistakable clinical features such as splenic enlargement, and prior illness and weakness, which were not present in this case. It is true, as Piney (1b) states, that "*the number of circulating leukocytes is not a feature of vital importance in the diagnosis of any of the leucoses*"; but one is entitled to believe that the well known clinical features are of importance, and if these are lacking, a diagnosis of chronic leukemia may reasonably remain in doubt.

And, if in this particular case, the clinical features of the sub-acute and chronic leukemias are lacking, this is much more certain of those of the acute forms. These may be insiduous at the beginning, but the terminal picture is that of a fulminating disease of terrible severity. Infection phenomena, severe chills, high fever, complete prostration, hemorrhages, purpuric manifestations, lasting from several days to weeks before death, all produce a syndrome which has deeply impressed those who have seen or written about it. The peripheral blood always shows marked qualitative changes, with a great excess of immature and pathological cells, sometimes very difficult to classify, and as far as I know, a leucocytosis as well; and, in the absence of these hematological findings, a clinical diagnosis of acute leukemia cannot be made. Naegeli (2a) gives an excellent clinical description of these types.

For these reasons, it was thought that the blood picture, as shown by the differential counts was *leukemoid* rather than *leukemic* or *aleukemic*. These counts were carefully made, using from three to six slides on each date, and counting not less than 200 cells on every slide.

At this time we had under observation several cases of sub-acute and chronic leukemia, and a careful comparison of the various cells could be made. It will be seen that, between October 29th and November 7th, the total neutrophil granulocytic cells fell from 61% to 18.4%. Such a drop as this might not be unusual as a terminal happening in true leukemia, but in this event there should be a large relative and actual increase in the younger cells of the myeloid series, and also in the immature non-granular cells. But the percentage of the *immature* eosinophiles, basophiles, and neutrophiles, most especially the last, remained fairly constant. The immature non-granular "stem" cells did increase from 3.25% to 18% on November 5th, with a fall to 11% on November 7th, but there was also an increase in the true, mature lymphocytes. The impression was that the myeloid function of the bone marrow was gradually being suppressed, probably by a replacement of this tissue with tumor cells. This impression was further strengthened by an examination of the biopsy imprint smears made on November 2nd, (Plate III, Figure 2), since the cells found in these resembled very closely the increasing immature cells of the peripheral blood. (Plate I, Figures 1, 2, 3, 4, 8; and also Supplementary Plate Ia.) It was also noted that the cells in the imprint smears were practically all of a type, and there was no evidence among them of a series of myeloid developing forms, whence it was inferred that, although true myeloblasts and their ontogenetic successors were present in the peripheral blood, another type of immature cell identical with the imprint cells, might also be present. This point is further discussed under the heading of "*Description of Cells in the Peripheral Blood and Tissues.*" Imprint smears made from the various tissues at autopsy also showed a similar picture. The cells were all of a type, without development into promyelocytes, myelocytes and older forms; and sections fixed in Zenker-formol and stained with hematoxylin and eosin likewise show no ontogenetic development. (Plate II, Figures 1 and 2; Plate III, Figure 1.) Dr. Getz, after a prolonged study of the hematoxylin and eosin sections, could find no evidence of development of the myeloid series, whereas in similar sections from a recent autopsy on a case of chronic myelogenous leukemia, the younger neutrophilic granulocytes could be distinguished.

Piney (1c) has a very interesting chapter on Leukemoid Blood Pictures. He states:

"*The only non-infective form of leukemoid reaction of importance is that seen accompanying the presence of lymphadenoma or of secondary deposits of malignant tumors in the bone marrow. . . . . There are two main types of blood change associated with metastatic tumors of the marrow: the one simulates pernicious anemia to some extent while the other is more definitely leukemoid.*" He notes that such growths irritate the surrounding myeloid tissue, and a variety of blood pictures, including the leukemoid, will result.

According to Richard C. Cabot (3a), the pseudoleukemia of the German writers is a "*hyperplasia of specifically hemopoietic tissue closely akin to leukemia, distinguished therefrom solely by the absence of 'leukemic' changes in the peripheral blood.*" In our case there was frequently more of an infiltration than a hyperplasia, and the blood showed definite leukemoid changes. Cabot states, however, that intermediate forms with slightly or moderately leukemic blood are recognized. The hemopoietic system as a whole or any of its parts may be affected.

Piney (1d) states that the term *pseudoleukemia* is taken by some writers to mean Hodgkin's disease, and by others to mean *aleukemic leukemia*; and he objects strongly to its use.

Chloroma is, of course, excluded by the clinical and autopsy reports.

Sternberg's leukosarcoma as described by Ewing (4) and Cabot (3b) appears to be a process anatomically intermediate between leukemia and sarcoma. In such literature as is available to me the hematological findings are not described in modern terms. "Atypical mononuclears" and "Atypical lymphocytes," when not further qualified, are expressions without meaning. It might help in this type of case if imprint smears, especially freshly made ones at biopsy or operation, were taken more frequently. The anatomists and others of the Unitarian school of hematology appear to have about exhausted the morphological appearances of cells as shown in the section methods, while the morphological features brought out by carefully made imprint smears, stained with modern methods, seem scarcely to be noted. Pappenheim (5a) made a plea for more of this work, and Downey (6a) has conclusively shown its value, at least to the microscopist. It is not intended to replace or even to substitute the use of well fixed and properly stained sections, but to supplement such use.

I do not find anything in the available reports on the *leukanemia* of Leuke and others to justify the consideration of such a diagnosis in this case. *Lymphoma* and *lymphadenoma* may, I believe, be excluded; particularly since the cells composing the infiltrations and tumors were not older lymphocytes, as is clearly shown in Figure 2, Plate III.

Striking clinical features were the pain, ptosis, diplopia and parathesias. Critchley and Greenfield (7), in discussing the neurological manifestations in the leukemias, refer to spinal symptoms caused by infiltration of the spinal meninges. Frequently the infiltration spreads, and involves the anterior and posterior nerve roots. The early symptoms are some sensory complaints, usually pain, which is generally severe and of sudden onset. Dr. Dart shows clearly that such a pathological condition existed in our case, and undoubtedly accounted for the neurological symptoms.

This case has attracted much interest among several authoritative hematologists to whom specimens of the blood and tissues were sent. It is sincerely hoped that further discussion and reports will be forthcoming. Dr. Dart has informed me that he hopes to publish later a complete series of photographic illustrations, making use of the excellent facilities afforded by the Army Medical Center in Washington. I am greatly indebted to Dr. Russell Haden, of the Cleveland Clinic, for his comments; to Dr. Wm. Bloom, of the Department of Anatomy of the University of Chicago, for comment and for his sections of the tissues stained by Maximow's method; and Dr. Wm. A. Groat, of the Syracuse University College of Medicine, for some fine three micra sections and very beautiful photographs, and for his opinion in this case.

I wish here to take this opportunity to express my deepest appreciation and thanks to Dr. R. O. Dart for his kindness and courtesy in making so exhaustive an autopsy report, without which our knowledge of this interesting case would have been indeed lacking.

I wish also to thank Dr. Sydney L. Chappell for his very careful and complete neurological reports. The outstanding clinical symptoms in this case were almost entirely neurological. The explanation, of course, is given by Dr. Dart's autopsy findings; and it is believed that this case will be of interest to Neurologists as well as to Clinicians and Pathologists.

DESCRIPTION OF CELLS IN THE PERIPHERAL BLOOD AND TISSUES

Plate I, and Plate III, Figure 2

Whatever may be said of the phylogenetic or ontogenetic position, in various *schema* of the development of the blood cells, with respect to the cell variously known as the myeloblast of Naegeli, the lymphoidocyte of Pappenheim, or the hemocytoblast of Ferrata, this cell, as Downey (6b) points out, is a definite morphological entity. It is characterized by a nucleus made up of very fine granules of basichromatin, sharply defined against a back ground of lighter oxychromatin, one or more nucleoli, a very delicate nuclear membrane, and a more or less abundant, clear, light blue cytoplasm, which does not contain granules. When the granules begin to appear, the cell is called a promyelocyte, and in this stage has been designated and figured erroneously as a myeloblast. The promyelocyte shows the oxidase reaction; but the true non-granular myeloblast, like other immature non-granular cells, does not show it, and so cannot be differentiated by its use.

In our case there were a few very definite and typical myeloblasts, similar to these shown in Plate I, Figures 10, 11 and 12, which are from a case of chronic myelogenous leukemia. But most of the immature or "stem" cells were large, lymphoid cells measuring from 12 to 20 *m*, many with a wide, clear abundant light blue non-granular cytoplasm. The nucleus (Plate I, Figures 1, 2, 3, 4 and also Supplementary Plate Ia), had a definite membrane, sometimes quite thick, and the basichromatin was in the form of a rather heavy net work, Figure 2, with patches or blotches, or in very heavy granules, Figures 1 and 3, and sometimes approaching in type that of the lymphocyte (Figures 4 and 8). Figure 9 shows a very interesting cell. The nucleus is lymphatic in type, the basichromatin and oxychromatin are not sharply defined, and the granules are identical with these seen in true lymphocytes, but the cell is immature (see the mature lymphocytes in Figure 7) and has morphological affinity with cells of the type shown in Figure 2.

Sometimes true transitional forms in the myeloid series could readily be followed. Figures 5 and 7 show promyelocytes with both azure and neutrophilic granules. Figure 7 is a typical promyelocyte. Figure 5 may be either a promyelocyte, or a histiocyte undergoing metaplasia. There were quite a few cells such as are shown in Figure 5; and sometimes they could not be differentiated, although most of them are classified as promyelocytes in the differential counts. Figure 13 shows a histiocyte with a few basophilic and neutrophilic granules. Between this cell and that shown in Figure 5, intermediate forms could be found.

It appears to me, and I record this opinion with diffidence, since I have no title to expert knowledge of hematology, that the direction of differentiation of the "stem" cells in the peripheral blood was lymphatic. The differential counts of Nov. 5 and Nov. 7 show a decided relative and actual increase in the number of lymphocytes. Most of these were mature, but I believe I could trace transitional forms from the type such as is shown in Figure 2, through the types shown in Figures 4, lower and upper cells, 8, and 9 to the mature type in Figure 7. At least, this transitional series seemed quite as definite as that found in the myeloid series. For comparison with the "stem" cells in our case are the myeloblasts from a case of chronic myelogenous leukemia (Figures 10, 11, 12); three immature cells from a case of subacute lymphatic leukemia in a child (Figure 19); one very immature cell with typical myeloblastic structure (Figure 14), and an immature lymphatic cell (Figure 15) from a terminal case of lymphatic leukemia in an adult; and two immature cells (Figures 16 and 17), from the femur marrow of a $4\frac{1}{2}$ months human fetus. Figures 16 and 17 are morphologically identical with many of the stem cells in our case, and there are hematologists who might call the cell in Figure 16 a "myeloblast," and that in Figure 17 a "lymphoblast."

The finding of a few typical myeloblasts in the peripheral blood in the leukemias and other diseases in which a myeloid blood picture may be present, is of itself no justification for a diagnosis of myelogenous leukemia. True myeloblasts can be found even in lymphatic leukemia, Figure 14, and they were also found in the blood in which the cells in Figure 19 were present.

The appearance of the cells in the tissues is shown in Plates II and III. Figure 2, Plate III, shows the morphology of the cells in a biopsy imprint smear made from the tumor of the gum removed by Dr. Reeder on November 2. The preparation was made immediately, dry fixed, and stained with May-Grünwald and Pappenheim. The large cell in the center is very immature, and truly myeloblastic in type, except for some heavy strands of chromatin. Five nucleoli can be seen. The nuclear membrane is not well defined. Wide meshed nuclei of histiocytic type are present, in the lower center, but somewhat out of focus. The appearance of the cells to the right of the center, with the more "lymphoblastic" type of nuclei (However, see also Supplementary Plate Ia, showing similar cells in the peripheral blood), may be due to the method of making an imprint smear. To show true morphological characteristics in imprint preparations by the dry smear method, the preparations must be fresh, very thin, and very quickly dried in *air*, as in well made blood films. Thickness and slowness in drying, alter the structure of the nucleus, as can readily be seen in blood films which are partly thick and partly thin. For these reasons, it is difficult to obtain imprint smears from marrow and other tissues which are properly comparable with correctly made blood films.

According to Cunningham and Tompkins (8), the use of a mixture of janus green and neutral red was adopted independently by M. E. Simpson and by F. R. Sabin for the study of the white blood cells; and has been used for the past ten years by many workers. A detailed account of the technique is given by Cunningham and Tompkins (8), and a lengthy critical review by Byron E. Hall (9), which is concerned mostly with the differentiation of the monocytes. Sabin and her co-workers, have published articles and very beautiful plates showing the appearance of the leukocytes in the leukemias, particularly an article in the Journal of Experimental Medicine, 1924, 40, 845.

During the past year, I have had the opportunity to study the use of this technique in two cases of lymphatic leukemia with many immature non-granular cells in the peripheral blood; three cases of chronic myelogenous leukemia showing frequent myeloblasts: several cases of so called "infectious mononucleosis," in which there were large, lymphoid, non granular cells that appeared to be intermediate forms between large lymphocytes and monocytes; cases of acute malaria with relatively numerous monocytes and histiocytes; and cases of anemia in children with marked lymphatic reaction in the blood. In one case not yet satisfactorily diagnosed, there were 60,000 nucleated erythrocytes per c. mm. in all stages of development; in another there is a lymphadenitis of undetermined origin, in which, in imprint smears from a gland removed at biopsy, immature cells indistinguishable from myeloblasts were found; also preparations from the heart blood, marrow, and liver from human fetuses were examined.

I found that in the tropics the warm stage is not necessary, since I could readily make out the appearances described in figures in the excellent illustrations at my disposal. Also, elaborate preparation of slides and cover-slips is not necessary for routine work. I use only new slides and cover-slips, cleaned in alcohol. A mixture of 1 drop of janus green to seven drops of neutral red* is spread on slides just as in making a blood film, and a small drop of blood taken up on a cover-slip, and then spread on the slide in the usual manner.

I have no difficulty in obtaining beautiful preparations. The better the optical system of the microscope, the illumination, and the skill of the microscopist, the better will be the results.

I have referred to this method somewhat in detail, since it is used extensively by certain hematologists, and there are those who assert that it is superior to dry fixed films for purposes of identification of the blood cells.

In our case the non-granular immature stem cells, when stained by this technique, were identical in appearance with those figured by Sabin *et al.* (10) as myeloblasts. They were likewise identical with the myeloblasts in the cases of myelogenous leukemia; the same type of cells in the fetal heart blood and tissues; and not a few of the cells in the cases of "infectious mononucleosis," anemia, the lymphatic leukemias, and the other cases referred to above. Even the large, immature "proerythroblasts" in the case with the 60,000 nucleated erythrocytes per c. mm. were morphologically identical with the immature non-granular white blood cells in the other cases. The mitochondria, which stain green, were arranged in a circle or wreath around the nucleus; and there was nothing in their number, size, shape or distribution, which was constant in any of the types of immature non-granular cells. The lymphocytes were quite distinctively shown, with clumping of the mitochondria. Monocytes sometimes showed the typical rosette of neutral red inclusions with the halo of mitochondria, and the histiocytes showed a variable amount of distribution of mitochondria and neutral red inclusions. The promyelocytes and myelocytes were as described by Sabin *et al.* (10).

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* These stains were obtained from Hynson, Westcott and Dunning, of Baltimore, Maryland, and were stated by that firm to be prepared according to the technique of Dr. Sabin.

However, I do not believe that the supravital technique, as described above, offers any advantages over a properly made dry fixed and stained preparation; and the latter is in many ways superior. The time of observation of the supravital preparations is limited under most favorable conditions. After an hour or so, the cells degenerate; and, in any event, one does not know whether one is dealing with appearances as they actually occur, or whether these are due to degeneration plus the toxic action of the stains. Also, in fresh blood preparations there is a marked tendency to uneven distribution of the cells, so that the monocytes and larger lymphocytes are often found in greater numbers at the periphery, whereas the differential count is made in the thinner part. In checking the differentials made by the supravital method against those on properly spread smears, I have found that the percentage of granulocytes is considerably higher in the former, and the percentage of lymphoid cells lower.

All of the studies of the peripheral blood and imprint smears, in the dry fixed preparations, were made by a combination of Jenner or May-Grünwald preliminary fixation and staining, followed by Pappenheim's stain. Haden's buffer solution was used in the place of water for diluting purposes and for differentiation after staining which is essential to clear cut pictures. This is the Panoptic staining of Pappenheim; and, properly done, yields very superior results. A good Giemsa stain will also serve, in place of the Pappenheim; and most workers use it.

The oxydase reaction gave no information of importance in our case.

Very few normal polymorphonuclear cells were seen at any time. The "young forms of granulocytes" noted in the differential counts include the metamyelocytes and band forms. Only the forms with definitely filamented nuclei were counted as polymorphonuclear cells.

The erythrocytes were constant around 2,800,000; and the hemoglobin, taken with the Newcomer colorimeter, remained about 50 to 55%. The color index was therefore high, about unity.

The number of normoblasts varied considerably. In the earlier counts they were from two to eight to 200 leukocytes. Later, they diminished to an average of about two. For the most part, they were about the size of the other erythrocytes. The majority were still rather immature, as shown by the "cart wheel" type of nucleus, and polychromatic cytoplasm. Occasionally, a much larger form was noted; but no megaloblastic type of nucleus was found.

There was a slight polychromasia, anisocytosis, and very occasional poikilocytosis. Most of the erythrocytes were normal in appearance.

The counting of the platelets was unfortunately omitted. In the slides, they appeared to be rather diminished in number.

DIFFERENTIAL LEUCOCYTE COUNTS

TOTAL LEUCOCYTES ABOUT 7,000 EACH COUNT

October 29, 1931

Basophiles	1.00%	
Eosinophilic myelocytes	1.00%	
Eosinophiles	7.00%	
Promyelocytes	1.50%	Total neutrophilic granular cells, 61.00%
Myelocytes	5.00%	
Young forms of granulocytes	46.50%	
Polymorphonuclear granulocytes	8.00%	
Lymphocytes	15.00%	
Monocytes	9.50%	
Stem cells	3.25%	
Türck forms	0.25%	
Neutrophilic histiocytes	1.25%	
Basophilic histiocytes	0.75%	
	100.00%	

October 30, 1931

Basophiles	1.00%	
Eosinophilis myelocytes	1.00%	
Eosinophiles	8.00%	
Promyelocytes	3.50%	Total neutrophilic granular cells, 55.7%
Myelocytes	7.00%	
Young forms of granulocytes	38.00%	
Polymorphonuclear granulocytes	7.25%	
Lymphocytes	15.00%	
Monocytes	12.25%	
Stem cells	5.75%	
Türck forms	0.25%	
Neutrophilic histiocytes	0.50%	
Basophilic histiocytes	0.50%	
	100.00%	

October 31, 1931

Basophilic myelocytes	0.167%	
Basophiles	1.333%	
Eosinophilic myelocytes	1.500%	
Eosinophiles	12.167%	
Promyelocytes	2.333%	Total neutrophilic granular cells, 54.832%
Myelocytes	5.333%	
Young forms of granulocytes	40.833%	
Polymorphonuclear granulocytes	6.333%	

Lymphocytes	16.500%	
Monocytes	7.167%	
Stem cells	5.667%	
Türck forms	0.000%	
Neutrophilic histiocytes	0.167%	
Basophilic histiocytes	0.333%	
	99.833%	

November 2, 1931

Basophiles	0.750%	
Eosinophilic promyelocytes	0.250%	
Eosinophilic myelocytes	1.500%	
Eosinophiles	8.750%	
Promyelocytes	2.750%	Total neutrophilic granular cells, 49.250%
Myelocytes	5.750%	
Young forms of granulocytes	35.750%	
Polymorphonuclear granulocytes	5.000%	
Lymphocytes	18.750%	
Monocytes	8.500%	
Stem cells	11.250%	
Türck forms	0.500%	
Neutrophilic histiocytes	0.500%	
Basophilic histiocytes	0.000%	
	100.000%	

November 4, 1931

Basophilic myelocytes	0.500%	
Basophiles	0.500%	
Eosinophilic myelocytes	0.750%	
Eosinophiles	13.000%	
Promyelocytes	5.500%	Total neutrophilic granular cells, 38.250%
Myelocytes	10.750%	
Young forms of granulocytes	20.250%	
Polymorphonuclear granulocytes	1.750%	
Lymphocytes	18.500%	
Monocytes	16.500%	
Stem cells	7.000%	
Türck forms	2.000%	
Neutrophilic histiocytes	2.000%	
Basophilic histiocytes	1.000%	
	100.000%	

November 5, 1931

Basophilic promyelocytes	0.125%	
Basophilic myelocytes	0.750%	
Basophiles	0.750%	
Eosinophilic myelocytes	1.375%	
Eosinophilic promyelocytes	0.375%	
Eosinophiles	8.750%	
Promyelocytes	5.875%	Total neutrophilic granular cells, 30.625%
Myelocytes	7.000%	
Young forms of granulocytes	15.500%	
Polymorphonuclear granulocytes	2.250%	
Lymphocytes	24.125%	
Monocytes	12.750%	
Stem cells	18.500%	
Türck forms	1.500%	
Neutrophilic histiocytes	0.375%	
Basophilic histiocytes	0.000%	
	100.000%	

November 7, 1931

Basophilic myelocytes	0.100%	
Basophiles	1.100%	
Eosinophilic promyelocytes	0.100%	
Eosinophilic myelocytes	1.300%	
Eosinophiles	6.000%	
Promyelocytes	2.100%	Total neutrophilic granular cells, 18.400%
Myelocytes	3.400%	
Young forms of granulocytes	10.600%	
Polymorphonuclear granulocytes	2.300%	
Lymphocytes	45.500%	
Monocytes	15.600%	
Stem cells	11.500%	
Türck forms	0.000%	
Neutrophilic histiocytes	0.100%	
Basophilic histiocytes	0.300%	
	100.000%	

ABSTRACT OF NEUROLOGICAL EXAMINATIONS

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October 26, 1931

NEUROLOGICAL EXAMINATION: Pupils equal, react slightly to light. Optic discs not seen because of small pupils. (Dr. Reeder informs me that he examined fundi under mydriatic, and they were normal. No evidence of choking of discs.)

Patient squints one eye when trying to see. Shuts one eyelid or the other. Usually the right, and keeps a towel over right eye most of the time. Sees double trying to use both eyes. In testing right eye movements, patient cannot carry it beyond midline toward temporal side. Same is true of left eye. Movements toward nasal side, both eyes O.K. Other movements of eye O.K. Corneal reflexes normal. No ptosis. No exophthalmus. There are a few nystagmoid movements in either eye in looking to right or left. Frowns, and wrinkles forehead. Shuts O.D. and opens O.S. Not vice versa. States he was never able to do this. The chin, including lower lip and skin as far down as lower anterior part of jaw bilaterally, shows sensory disturbances. Appears to feel touch over this area, but not as acutely as in other areas. Fails to distinguish sharp and dull over this area and two point differentiation is below normal. No definite evidence of facial flattening, although left side may be slightly less lined than right. In tests showing teeth, etc., there seems to be no difference. Tongue protrudes in midline. States he swallows normally and food tastes O.K. Hearing good in both ears. Speech is rough and harsh. No special difficulty noted. No tenderness on percussion over cranium.

Deep arm and leg reflexes equal and about normal. No Babinski or Romberg. Coordination: F.F., F.N., and H.K.—O.K. No tremors of note. No adiadokokinesis (dyssynergia). No atrophies, paralyses or spasm, except as noted under eyes. Muscle power of extremities equal, good, and well sustained. Sensation, except over chin, normal to touch and pain. Vibration sense and sense of position normal. No tenderness on pressure over upper parts of crests of both ilia. No vasomotor changes. It was also observed that patient has a marked enlargement of glands of right side of neck. This is understood to have developed in past three days. For first week in hospital, temperature averaged about 99°. On one day it was as high as 100. Since first week, temperature has been practically normal.

OPINION: The history of case, numbness of chin about September 25th, extraction of two teeth September 28th, development of pain, tingling and formication in chin about October 2, onset of diplopia about October 1, and development of neuritic like pains in hips, and legs, are very suggestive to me that the symptoms of bilateral paralysis of the 6th cranial nerve are a part of an infectious neuritis. Cranial nerve paralyses do occur as part of a general neuritis. It seems to me that the facts that the 6th nerves are affected, as well as both sides of chin, together with absence of choked disc and other general signs of intra-cranial pressure, point against an intra-cranial tumor.

November 6, 1931

Dr. James informed me that the white blood cells showed a picture of myelogenous leukemia, although the spleen was not enlarged and the white cell count was not increased. He stated that the patient did not have leukemia, and that bone tumors may produce this picture. An X-ray of jaw shows areas which are suspicious of bone tumor.

A spinal fluid test was done this A.M. Dr. Runyan states the fluid was clear and not under pressure. Tests may possibly clear up some of the puzzling features of this case. The patient is more retarded and dull than when last seen. Evidently is gradually growing more stuporous as he grows worse. Can be aroused. Tries to do what he is told to do. Now has a ptosis of right eyelid. Very difficult to make him look to either right or left with either eye. Seems able to look to left with right eye at times. In opening eyes, they seem to be fixed in center. Pupils are about normal in size, and equal. Certainly not dilated in either eye. (Dr. Reeder informs me that he again dilated pupils a couple of days ago, and discs were normal.) Deep reflexes very hard to obtain. Apparently are present but weak at patellae. Ankle jerks respond. Abdominal reflexes respond. Seems to differentiate sharp and dull sensations except in chin, although makes number of errors apparently from inattention. In the central part of chin and lips makes no responses to touch and pain sense. Moves legs and arms. No gross paralyses other than in eye muscles. No Babinski.

The physicians at Panama Hospital feel certain, because of tumor of right neck, the blood picture, and X-ray findings of the jaw, that the patient has a malignant tumor or tumors and that there is involvement of bone in the process. It would therefore seem more rational to explain the neurological status on the same etiological basis.

The essential neurological history is as follows:

1—About September 25, 1931, numbness of chin and lower lip.

2—September 28th, two teeth extracted. Followed by pain, numbness and formication for four days. Then numbness again.

3—About October 1. Double vision found to be due to external rectus paralysis on admission to Panama Hospital, October 4.

4—October 8. Development of pain across back of hips and into legs and thighs.

5—October 26. First noted double rectus (6th cranial nerve) paralysis (and large swelling right side of neck). It would appear now that there is partial involvement of the 3rd right cranial nerve in addition to double paralysis of both 6th cranial nerves. If the ptosis was due to a peripheral condition, we would expect complete paralysis of the whole nerve. Theoretically, the cause is more likely to be cerebral tumor metatasis. Small tumor in pontine area may account for the neurological signs. Possibly there is a small pontine tumor on both right and left side. A tumor on one side large enough to cause an abducens paralysis on the other should certainly give other paralytic symptoms. It is difficult, under any conditions, to explain the absence of other paralytic signs if the tumor is pontine. A tumor in that area would explain why we have not seen the general signs of intra-cranial tumor, such as choked disc, vomiting, etc. The general physical findings appear to rule out lethargic encephalitis, although the picking out of individual cranial nerves is very characteristic of that disease.

Finally, the prognosis seems very grave; and we may not know the real neurological condition until later on.

ROENTGENOLOGIC REPORT

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Hospital de Panama, and Santo Tomas Hospital

Roentgenologic examinations were made as follows:

October 5, 1931: Teeth; no dental infection has been observed; however, the gums are considerably retracted and considerable amounts of food debris may gather between the teeth.

October 16, 1931: Jaw; ragged surface of mandible. Periostitis.

October 26, 1931: Sella turcica; the roentgenograms taken of the head present the sella turcica apparently normal.

October 26, 1931: Jaw; the roentgenograms taken of the left lower jaw present destructive changes with very little new bone formation. Bone destruction predominates by far, and is gradually spreading from day to day. The process started around the region of the 1st bicuspid, and has apparently spread back to the angle of the jaw. The process apparently started in the medulla of the bone and spread rather rapidly, destroying the bone along its path without any expansion. The general appearance, therefore, is that of a malignant process; which is considered to be the condition present.

October 26, 1931: Cervical spine; the roentgenograms taken of the cervical spine show calcification of the arteries on both sides of the spine. There is also some probable inter-vertebral arthritis. This, however, might be expected in a person of this age and sex.

October 26, 1931: Chest; a teleo-roentgenogram taken of the thorax presents some enlargement and thickening of the arch of the aorta. There is also an increase in the shadow of the left ventricle; conditions which are more or less normal for a person of this age and sex, and particularly in arteriosclerosis.

AUTOPSY REPORT

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PATHOLOGIST, BOARD OF HEALTH LABORATORY, THE GORGAS HOSPITAL
ANCON, CANAL ZONE

This patient died in the Hospital de Panama, about 9 p.m., Nov. 7, 1931; and, because of the unusual nature of the case which made it desirable to fix the tissues as soon as possible after death, autopsy was performed at 11 p.m. the same date. The appearance of the tissues was consequently considerably altered by artificial light.

AUTOPSY FINDINGS

External Examination: This is the body of a well developed and fairly well nourished white male, 64 inches long, weighing 112½ pounds and anatomically about the stated age of 56 years. The hair is thin, black and partially bald. There are no lesions in the scalp. The eyebrows are bushy and black color. The irides are blue, the pupils are equal in size, round and regular in outline, and moderately dilated. The mucous membranes of the mouth are pale. All of the molars in the upper jaw are missing. The incisors and premolars are present. The lower jaw is completely edentulous. There is moderate thickening of the gums on both sides of the lower jaw. The mucosa covering the tissue is opaque white color. There are three recent lesions in the mucous membranes. One is situated behind the former position of the left lower canine. The other two correspond to the former positions of the third molars on both sides. Each of these lesions has the appearance of a recently extracted tooth in which the cavity is filled with soft, red, dark granulation tissue. Sections through the bone and through two of these lesions show soft red tissue, extending deeply into the marrow of the mandible. The bone marrow adjacent to these lesions is pale and has an opaque appearance. There is an asymmetrical swelling in the right side of the neck beneath the right sternocleiodomastoid muscle. The skin is freely movable over this mass, but the muscle is adherent to the underlying tissue. There is a small, poorly defined, bluish tattoo mark on the dorsal surface of the left arm. Linear tattoo marks are stretched across the dorsum of the fingers on the left hand. There is an old atrophic scar of a former appendectomy incision on the right lower quadrant of the abdomen. The skin of the lower extremities is the seat of numerous fine petechial hemorrhages which resemble dependent areas of the body. Rigor mortis is not yet established. Body heat is still present.

HEAD AND NECK

Scalp: Normal.

Skull: Normal thickness and contour. The bony cavities are clear.

Meninges: No lesions are found in the dura. The pia-arachnoid membranes are thin, transparent, but slightly thickened over the structures at the base of the brain. The vessels at the base of the brain are normal in caliber, thin walled and collapsed. The cerebrospinal fluid is clear.

Brain: No grossly visible abnormalities are found on the external or sectioned surfaces of the brain and the upper end of the cord. The lining of each of the ventricles is smooth and normal in appearance. The choroidal plexuses contain multiple small cysts.

Throat and Neck: The surface of the tongue is covered with a dark brown exudate. Both tonsils are markedly enlarged, firm, and show ragged gray ulcerations in their centers. Sections through the base of the tongue show no infiltration into the musculature. The larynx, trachea and esophagus are normal in appearance. Upon dissection of the anterior portion of the neck, a soft opaque white tumor, roughly 6 x 4 cm. in diameter, occupies all of the right lobe of the thyroid gland. This tumor has an encepholoid appearance, but is mottled with areas of dark brown shade. Although fairly sharply outlined, there is an extension of the process upward and to the right; so that infiltrating masses of softened white or brown tumor tissue extend through the capsule of the thyroid into the muscles and fascia on the right side of the neck. This infiltrating mass extends upward as high as the top of the larynx and spreads diffusely through the body of the sternocleidomastoid muscle. Small softened tumor masses, averaging the size of lima beans, extend along the left ramus of the mandible to the point of the chin and downward into the anterior cervical nodes on the right side of the neck. The lower border of the tumor is sharply demarcated at the base of the thyroid gland. The right carotid artery and the right internal jugular vein extend through the masses of tumor tissue, but the intimal lining of the vessels is smooth and the lumina are free from evidence of tumor masses. The isthmus and left lobe of the thyroid are small and normal in appearance.

THORAX

Pleura: There are a few old fibrous adhesions over the posterior surface of the right lung. Both pleural cavities are otherwise negative.

Lymph Nodes: The bronchial lymph nodes are moderately enlarged, softened, and jet black color. They show no areas of calcification or evidence of tuberculous infiltration.

Lungs: The external and sectioned surfaces of the lungs are grossly negative. There is only mild congestion in the dependent areas of both lower lobes.

Pericardium: Normal.

Heart: The heart is normal in size and shape. The subpericardial fat is increased in amount and shows patches of raised contour and increased density at the base of the ventricles on the anterior surface. Sections through these lesions encounter areas of diffuse opaque white color, similar to the tumor masses described in the thyroid. The external surfaces of the auricles and the auricular appendages are dull and opaque in appearance. There is slight thickening in the auricular walls; which, on section, have a yellow or pale appearance. These occur near the coronary sulcus. The musculature is otherwise normal in appearance. No lesions are found on any of the valvular structures and the mural endocardium appears normal.

Aorta and Branches: Save for a few poorly defined yellow subintimal infiltrations in the arch, these structures appear normal.

ABDOMEN

Peritoneum: There are numerous old fibrous adhesions in the peritoneal cavity. The omentum is densely adherent to the anterior abdominal wall around the appendectomy scar. The coils of the ileum are matted together by old fibrous adhesions so that they are separated with considerable difficulty. None of these lesions cause narrowing of the lumen of the gut. The appendix has been previously removed. There are old adhesions between the surface of the gall bladder and the transverse colon. The intra-abdominal fat is fairly abundant and has a bright yellow color. The retro-peritoneal fat surrounding the left kidney is bulging with a diffuse infiltration of soft encephaloid tumor tissue which surrounds the left adrenal and extends upward and inward from the upper pole of the kidney. Owing to the soft character of the tumor, none of the vessels transversing this region show evidence of occlusion. The tail of the pancreas is imbedded in the tumor. The lymph nodes surrounding the celiac axis and upward along both sides of the gall bladder are enlarged and similar in appearance to those described in the neck. Upon dissection, the left adrenal can be entirely separated from the surrounding tissue in which it is imbedded. There is a large lymph node in the mesentery, measuring 2 x 3 cm., which on section is mottled pale gray and lavender shade. It is softened in consistence, like all other regions in which the tumor is found. The pelvic fat is diffusely infiltrated with soft masses of tissue similar to that found around the left kidney. These invade the seminal vesicles and the prostate, and extend upward along both sides of the bladder. Although both ureters are imbedded in this tissue, they show no evidence of occlusion or narrowing of their lumina. The left ileo psoas muscle is infiltrated with recently extravasated blood.

Lymph Nodes: The lesions in the lymph nodes around the celiac axis are described. The retro-peritoneal nodes along both sides of the aorta average 1 cm. in length.

Liver: This organ is markedly enlarged. The capsule is smooth, dark brown color, but the seat of scattered flattened nodules over both the upper and lower surfaces of the organ. They are pale gray in color, mottled with areas of lavender; and are surrounded by zones of dark red color. They average 2 cm. in diameter. The sectioned surfaces of the liver are pale brown color, finely mottled with minute gray flecks corresponding to the lobular pattern. The tumor nodules seen on the external surface are found throughout the substance of the liver. They are widely scattered and sharply circumscribed, except in the region of the attachment of the falciform ligament, where they form diffuse masses through the liver tissue. The wall of the gall bladder is normal in thickness and the biliary passages are negative.

Spleen: This organ is slightly enlarged. It is firm and rubbery in consistency. The capsule is slightly thickened, and has a granular appearance due to flecks of dark golden brown and red color. The sectioned surfaces are very dark mahogany shade, moist, glistening and homogenous in appearance. The architectural pattern is indistinct. The pulp is fairly firm and does not scrape. No grossly visible evidence of tumor infiltration occurs in the splenic pulp.

Pancreas and Adrenals: The tail of the pancreas and the left adrenal are imbedded in a mass of tumor around the left kidney. They show no grossly visible intrinsic lesions. The cortical areas of the adrenals are thin, brilliant yellow in color, and finely granular in appearance. The medullary structure is dark brown and softened.

Kidneys: Both kidneys are enlarged, firm, but normal in shape. The external surfaces are nodular in contour, due to numerous areas of raised contour and gray color. The intervening structure is dark brown shade. The capsules strip easily, and are only slightly thickened. The sectioned surfaces are slightly increased in width, but the architectural pattern is distorted by numerous diffuse gray infiltrations which shade gradually into the intervening brown parenchyma. There are no lesions in the renal pelves or in the ureters.

Bladder: The mucosa of the bladder is normal in appearance. The wall is thickened by the external infiltrations described.

Genital Organs: Negative.

Stomach and Intestines: There is a small circular ulceration in the mucosa of the duodenum. This overlies a firm and buttonlike nodule in the wall. The mucosa over the nodule is dark brown color, ragged and granular in appearance. A similar lesion is encountered in approximately the middle of the ileum. Both of these lesions measure approximately 12 mm. in diameter. The gastro-intestinal tract is otherwise negative.

OTHER EXAMINATIONS

Bones and Joints: The lesions in the jaw have been described. The periosteum of the bones throughout the body has multiple, small, raised, sharply circumscribed hemorrhagic infiltrations. These occur along the length of the vertebral column, over the periosteum of the pelvis, sternum, ribs, and the femur. Their distribution indicates that they probably occur throughout all of the bony skeleton. The lesions do not penetrate into the cortex of the bone, and appear hemorrhagic rather than neoplastic in nature. The bone marrow in the shaft of the femur is yellow, moderately firm, but mottled with areas of dark brown.

Muscles and subcutaneous tissues: Negative.

Urine: Not examined.

Feces: Negative for intestinal parasites.

Smears from the brain, spleen and bone marrow: Negative for malarial parasites and pigment.

Blood Wassermann: Negative.

Spinal Fluid: Wassermann negative. Ammonium sulphate negative. Phenol one plus. Colloid gold: 0000111000.

Blood Chemistry:

	Milligrams per 100 cc.
Non-protein nitrogen	180.3
Urea nitrogen	138.0
Creatinin	2.3
Glucose	77.0

Weight of Organs

Brain	1410 grams	Left lung	250 grams
Liver	2295 grams	Right lung	325 grams
Spleen	250 grams	Kidneys, combined	430 grams
Heart	325 grams	Body weight	112½ pounds

MICROSCOPICAL EXAMINATION

Brain: The meninges at the base of the brain contain small leukemic cellular deposits, which are more marked about the point of exit of the cranial nerves. The latter show "patchily" distributed areas of degeneration. The brain is congested, mildly edematous, and shows mild thickening of the blood vessel walls. Occasional areas contain corpora amylacea. There are areas of degeneration in the pons and medulla which occur principally beneath the floor of the fourth ventricle.

Pituitary: The pituitary is enlarged by marked leukemic infiltration of the capsule and the peripheral zones of the gland. In some portions this process is accompanied by considerable fibrosis with cicatricial contraction and the formation of dense masses of densely stained thread-like nuclei.

Thyroid: One of the slides shows a dense leukemic deposit. In another the outlines of atrophic acini can be seen between the masses of leukemic cells.

Tonsil: The architectural pattern of the tonsil is apparently normal. The follicles are fairly well demarcated and apparently normal in appearance. The lymphoid structure of the pulp is increased in amount and composed of densely stained lymphocytes.

In one field there is an infiltration of larger cells of the myeloid series. This is accompanied by production of considerable fibrosis and cicatricial contraction. Clumps of densely stained immature cells suggest proliferative activity.

Gums: Sections through the thickening in the gums show no alteration in the mucous membrane. The nodule is composed of a dense infiltration of cells which, in some areas, resemble bone marrow. These areas vary in density and occasionally contain considerable fibrosis. The individual cells are chiefly large immature myelocytes, but there is marked degeneration and necrosis and marked phagocytic activity. Areas of this infiltration have an almost hemorrhagic appearance. Many nucleated reds are found in these regions.

Lymph Nodes: Sections through the tracheobronchial lymph nodes show myeloid replacement of the normal lymphocytes. In this process there are numerous large phagocytic cells containing the debris of degenerated leucocytes. Large numbers of cells are in mitosis. In the mesenteric node, practically all of the architecture is distorted by this cellular infiltration. In some areas immature cells lie between normal appearing lymphocytes. In others, the lymphocytes are reduced in number or completely crowded out. The leukemic cells invade the capsule and the surrounding fat.

Lung: There is mild thickening of the blood vessel walls and areas of the lung parenchyma are collapsed. There are no inflammatory lesions in the lungs. Some of the lymphoid structures along the bronchi contain heteroplastic leukemic deposits. These are small and inconspicuous.

Heart: Sections through the auricular wall show diffuse leukemic infiltration between the muscle cells and in the subpericardial fat. The muscle fibres in the ventricles are the seat of a mild parenchymatous degeneration. The interstitial connective tissues are edematous. There is mild thickening of the blood vessel walls, chiefly due to localized plaques of subintimal infiltration.

Liver: Sections through the tumor nodules described in the gross show diffuse infiltrations of leukemic character, in which the outlines of atrophic liver cells can still be seen. This process is not sharply demarcated from the surrounding liver parenchyma. All of the portal areas are infiltrated with leukemic deposits of different size and degree. The liver cells are swollen, granular, and frequently the seat of fine vacuoles. There are increased numbers of immature leucocytes in the sinusoids. The liver cells are pigmented.

Spleen: The architecture of the spleen is markedly altered by diffuse cellular change in the pulp which resembles that described in the lymph node but is characterized by the presence of a large amount of blood between tumor cells.

Pancreas: Sections through the tail of the pancreas show a diffuse leukemic infiltration between the atrophic acini. The islands of Langerhans stand out prominently in this process.

Adrenal: In this section the capsule and the surrounding adrenal fat are infiltrated with leukemic cells. The process extends through the capsule into the cortical areas in some places, but is principally confined to the perirenal fat. Small localized deposits are occasionally found in the gland.

Kidney: The architecture of the kidney is distorted by large, diffuse areas of leukemic infiltration in the interstitial tissues. The intervening areas are markedly congested, show numerous petechial hemorrhages, and mild interstitial edema. The epithelium lining of the tubules is frequently thin, and densely stained; and there is a mild granular precipitate in the tubular lumina.

Seminal Vesicle: The fibrous tissue and the surrounding fat are profusely infiltrated with leukemic cells similar to the others described. There are no inflammatory or other lesions in the ducts.

Intestine: Sections show a nodule of leukemic infiltration which replaces part of the mucosa and spreads diffusely through the adjacent mucosa.

Bone Marrow: Sections from the bone marrow of the femur show islands of dense myeloblastic activity. In these regions the cells practically replace the fat. In other areas the fat is normal in appearance.

ANATOMICAL DIAGNOSIS

Scar, appendectomy, old.
Anemia.
Hemorrhages, petechial, skin.
Ulcers of tonsils.
Atheroma, aorta, mild.
Adhesions, abdominal, old.
Infiltrations, leukemic; of meninges, thyroid, heart, lungs, liver, kidneys, spleen, intestines, lymph nodes, bone marrow, and retro-peritoneal fat.
Degeneration, albuminous; of all parenchymatous organs.

Note: The type cells in all of the lesions found are large and fairly uniform in size. They have large, round, oval, indented or occasionally lobulated nuclei; and fairly abundant cytoplasm. The low leucocyte count, (around 7000), the presence of a tumor in the neck, and the signs of malignancy in the nodules, suggest lymphosarcoma of the reticulum cell type. This is further supported by the nodules in the liver and many of the lymph nodes. Careful examination of the nodules show occasional eosinophiles and metamyelocytes. The wide distribution of the lesions, the type of all, and the heteroplastic rather than metastatic origin, are typically leukemic in nature. All of the lymphatic tissues and the bone marrow show changes of varying degree. There is marked anemia and numerous nucleated red cells. Although the total number of leucocytes was not high, the differential counts showed marked changes with numerous immature cells of the granulocytic series. Since the patient was seen only a short time before death, it is impossible to state whether the low leucocyte count represented a temporary reduction, such as occurs in all forms of leukemia, or whether this is a case of myeloid aleukemic leukemia.

Cause of Death: Myelogenous leukemia (65a).

Autopsy was performed by Dr. Raymond O. Dart.

Sgd. L. B. BATES, M.D., F.A.C.P.,
Chief of Laboratory.

DESCRIPTION OF PLATES

Figures 1, 3, 4, 5, 6, 15 and 19, magnification 1200x. Plate I:—These photographs, as well as Figures 1 & 2 on Plate II and Figure 1 on Plate III, and also those of Supplementary Plate Ia, were very kindly sent to me by Dr. Wm. A. Groat, of the Syracuse University College of Medicine; and were taken by Miss Stella Zimmer, the photographer of that institution. Figures 1 & 2, Plate II, and Figure 1, Plate III, were very kindly selected by Dr. Herman G. Weiskotten, Professor of Pathology and Dean of the Syracuse University College of Medicine. The captions of Plates IV, V, and VI were very kindly furnished by Dr. Lawrence Getz, B.A., F.A.C.P., Chief of Laboratory and Pathologist to the Herrick Clinic and Hospital de Panama, in the absence of Dr. Dart, who had left on an extended vacation.

PLATE I

Figure 1.—Immature or "stem" cell in the peripheral blood, showing the granular chromatin formation, with two nucleoli. The cytoplasm is a clear light blue and is non-granulated.

Figure 2, 750x.—Stem cell, showing "lymphoblastic" nucleus. The chromatin shows heavy patches and meshes.

Figure 3.—Stem cell with heavily staining basichromatin arranged in the form of coarse granules. The nuclear membrane is distinct and thick.

Figure 4.—Stem cell below, with lymphocyte above.

Figure 5.—Promyelocyte. The granules show the typical basophilic azure staining. A few neutrophilic granules are beginning to appear.

Figure 6.—Mitosis in stem cell.

Figure 7, 750x.—Early pro-myelocyte. The remains of the nucleoli are distinctly seen. Below are three lymphocytes and above is a monocyte, probably at the end of amitotic division.

Figure 8, 750x.—Stem cell with "lymphocytic" type of nucleus.

Figure 9, 750x.—This cell shows an immature lymphocytic nucleus. The cytoplasm is a pale blue, and the granules were exactly similar to those seen in mature lymphocytes. This cell, morphologically, seems to lie between the immature stem cells and mature lymphocytes.

Figures 10, 11, 12.—These are typical non-granulated myeloblasts from a case of chronic myelogenous leukemia. Figure 10 is probably the most immature of the three. Figure 12, is the "leukoblastic" type of Pappenheim (5b). Very few cells corresponding to these were found in the peripheral blood of the case under discussion. It will be seen by a comparison with the other stem cells that these myeloblasts show a much more delicate and more finely granular nucleus. Nucleoli are present in all of them.

Figure 13, 750x.—Histiocyte in the peripheral blood. This cell contained both basophilic and neutrophilic granules. Note the heavy, thick nuclear membrane and the nucleoli. As a rule the histiocytes contain a rather coarser chromatin net-work in the nucleus than is shown here. This cell is the haemohistioblast of Ferrata. It is very fragile and is often confused with broken down granulocytes; however, in the leukemias and in some other diseases, especially malaria, typical forms can often be readily found, and a study of these shows as Richter (11) and Dameshek (12) have claimed, that they are true reticular-endothelial cells such as are seen in considerable numbers in imprint and smear slides from the liver, bone marrow and spleen.

Figure 14, 750x, and Figure 15, 1200x.—Very immature cells from a case of terminal lymphatic leukemia with autopsy diagnosis. Figure 14 shows a cell with typical myeloblastic structure. In Figure 15, the cell is beginning to take on lymphatic characteristics.

Figures 16 & 17, 750x.—These are very immature cells from a freshly made imprint smear of human fetal bone marrow at 4½ months. These cells bear a very striking resemblance to the stem cells of the case under discussion. They are also very similar to the cells shown in Plate III, Figure 2. The nuclei are somewhat coarser in structure than the myeloblasts in Figures 10, 11 & 12.

Figure 18, 750x.—From the same source as figures 16 and 17. Immature bone marrow cell at the end of mitosis.

Figure 19.—Three immature cells from a case of sub-acute lymphatic leukemia. These show a much coarser structure than do the myeloblasts, but there were present in this particular case all stages of morphological transition between these cells and typical myeloblasts on the one hand, and mature lymphocytes on the other. These cells are similar to the micromyeloblasts of Naegeli (2b) and the microlymphoidocytes of Pappenheim (5c), but the direction of differentiation was almost entirely lymphatic, although a few series of myeloid differentiation were also seen.

SUPPLEMENTARY PLATE Ia

All magnifications 1200x

These photographs were kindly furnished at my special request by Dr. Groat, in order to give as much information as possible as to the appearance of the "stem" or immature cells found in the peripheral blood of the case under discussion.

Figure 1.—This may be a "Rieder" form, or a form of amitotic division, probably the former, since true mitotic figures were seen occasionally in the peripheral blood and in abundance in the imprint smears. Naegeli believes that the "Rieder" forms are characteristic of acute myeloblastic leukemia.

Figure 2.—The heavy, coarse, basichromatin net work is very well shown here. This cell according to Pappenheim is "amblyochromatic," as it shows a dark nucleus with much chromatin, and the net work is too coarse to be described as "leptochromatic." From the plates and figures I have available, it seems to me that it is closer to the "leukoblast" of Pappenheim than anything else. "Leptochromatic" refers to the fine stippling or very finely woven net work of the nucleus of the true myeloblast.

Figure 3.—A cell similar to that described in figure 2, but with the chromatin in a much coarser net work. This nucleus is "pachychromatic." The term is used by Pappenheim to describe the coarse structure of the lymphocyte nucleus. These definitions are taken from Downey's (6b) article on the Myeloblast, page 375.

Figure 4.—Immature cell from a case of sub-acute lymphatic leukemia. The structure here is "leptochromatic," but the cell itself is "amblyochromatic."

Figure 5.—Two stem cells with coarse nuclear structure. The nucleus of the lower cell is probably in mitosis.

Figure 6.—Cells from Dr. W. A. Groat's case of acute myeloblastic leukemia, very kindly sent by him for purposes of comparison. Wright's stain.

PLATE II

Figure 1, 1200x.—Bone marrow in a three micra section stained with hematoxylin and eosin.

Figure 2, 1200x.—Similar section from the kidney.

PLATE III

Figure 1, 1200x.—Three micra, similar section from the liver. This, and the preceding two figures show all that can be seen of cell morphology after the section method with hematoxylin and eosin staining.

Figure 2, 750x.—Imprint smear from biopsy tumor of gum. These cells are morphologically identical with the immature cells of the peripheral blood, as can be seen by a comparison with the figures on Plate I. Dry fixed, May-Grunwald and Pappenheim staining. This figure shows clearly the use of the imprint method, with dry fixation and good staining, in the study of the morphology of the cells under discussion.

The photographs in plates IV, V, and VI were made with a Leitz Mifilmca film camera, which gave an initial magnification of 1/3 the actual magnification. In making the enlargements to bring these up to actual magnification, the photographer was requested to emphasize the cellular infiltration; for this reason the parenchymal tissue is slightly out of focus.

PLATE IV

All magnifications 80x

Figure 1.—Tumor infiltration of adrenal gland. View from side gives suggestion of zona fasciculata and zona reticularis.

Figure 2.—Tumor replacement of bone marrow cells.

Figure 3.—Tumor infiltration of small intestine. Note the disappearance of normal structures in the mucosal interstitial tissue and in the sub-mucosa.

Figure 4.—Tumor infiltration of submucosal tissue of gum. The mucous membrane is well preserved. Tumor cells are noted in the papillae.

Figure 5.—Tumor cells infiltrating liver parenchyma.

Figure 6.—Tumor cells infiltrating liver parenchyma.

PLATE V

All magnifications 80x

Figure 7.—Tumor cells in periportal area of liver.

Figure 8.—Tumor cells in cortex of kidney. Note the architectural distortion and replacement by tumor.

Figure 9.—Tumor infiltration in interstitial tissue of renal cortex.

Figure 10.—Tumor replacement of lymph gland tissue. Note remains of capsule and infiltration of adventitial tissue.

Figure 11.—Tumor infiltration of parenchyma of pancreas.

Figure 12.—Tumor infiltration of parenchyma of pancreas. Note islands of Langerhans are well preserved.

PLATE VI

All magnifications 80x

Figure 13.—Tumor infiltration in interstitial tissue of seminal vesicles.

Figure 14.—Tumor infiltration of spleen.

Figure 15.—Tumor infiltration in heart muscle. Note the atrophy and disappearance of the fasciculi.

Figure 16.—Same as above.

Figure 17.—Tumor infiltration and replacement of glandular tissue of pars anterior of hypophysis cerebri.

Figure 18.—Tumor infiltration in interstitial tissue of thyroid with involvement of glandular elements.

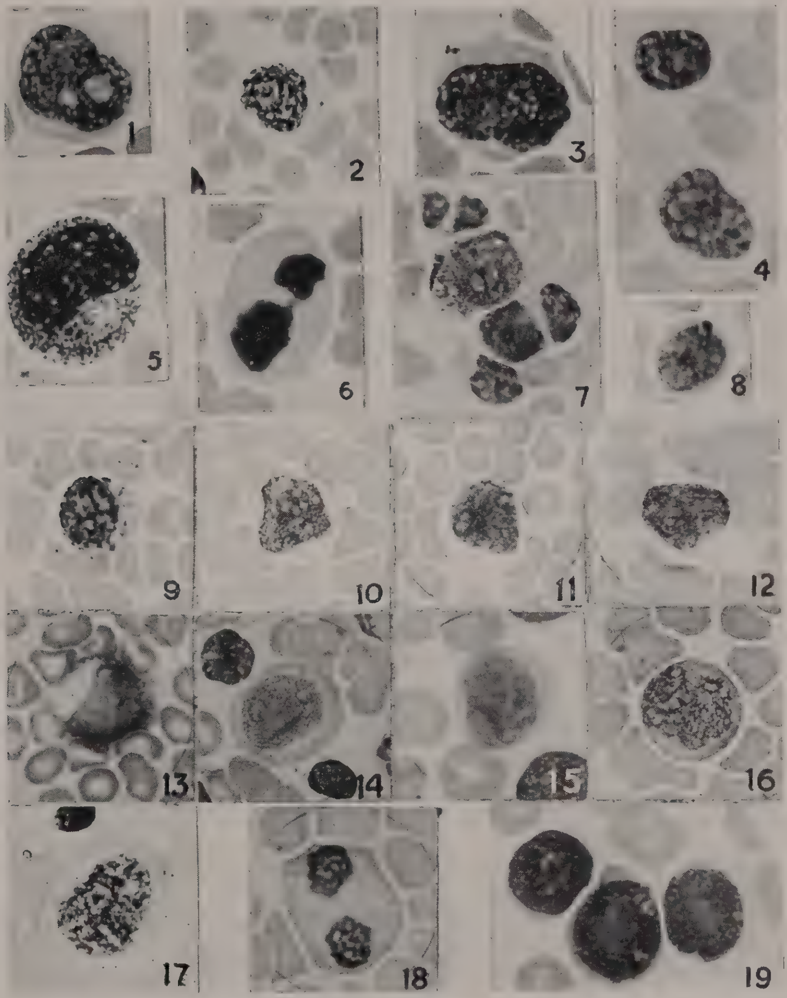

PLATE I

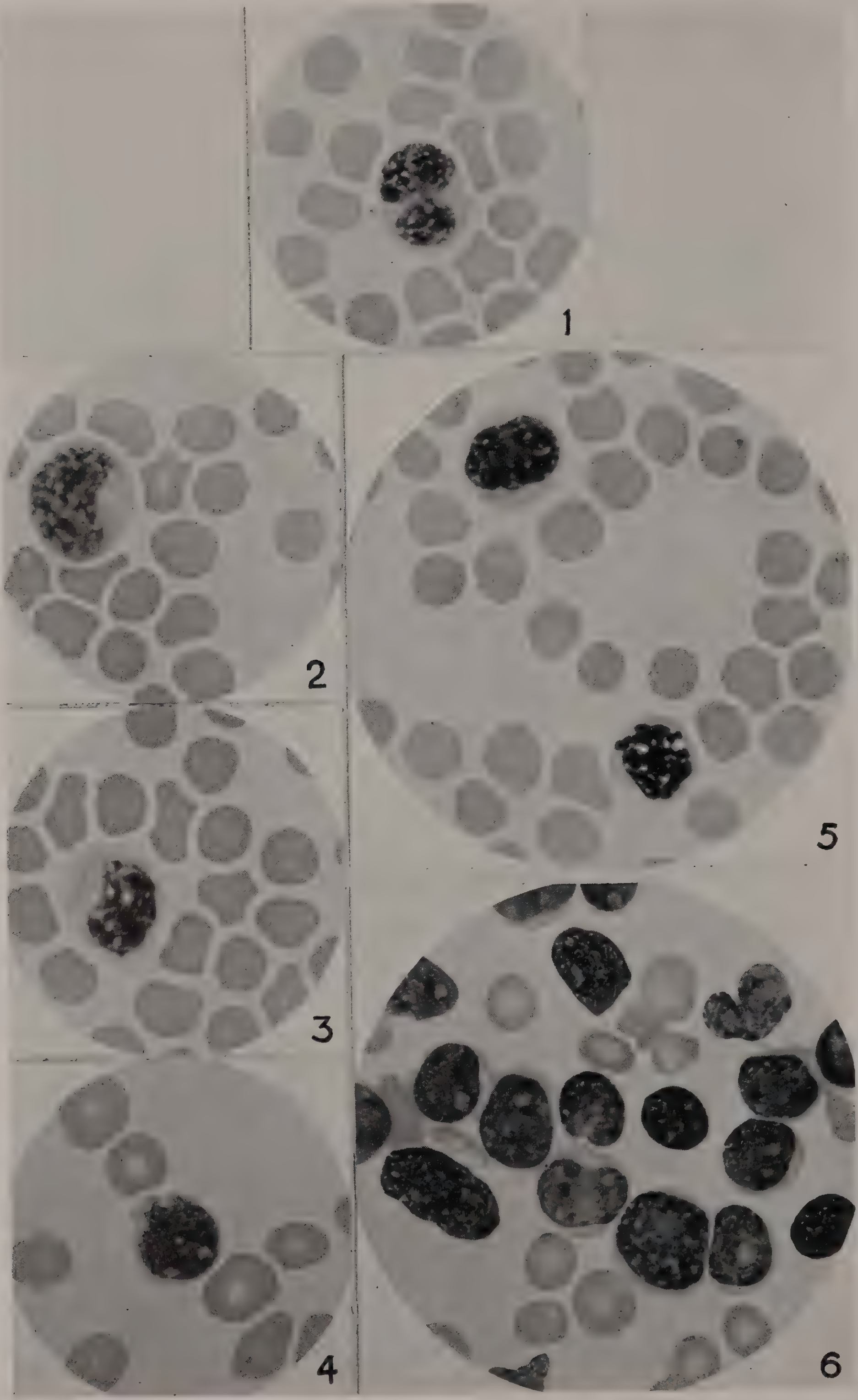

PLATE Ia

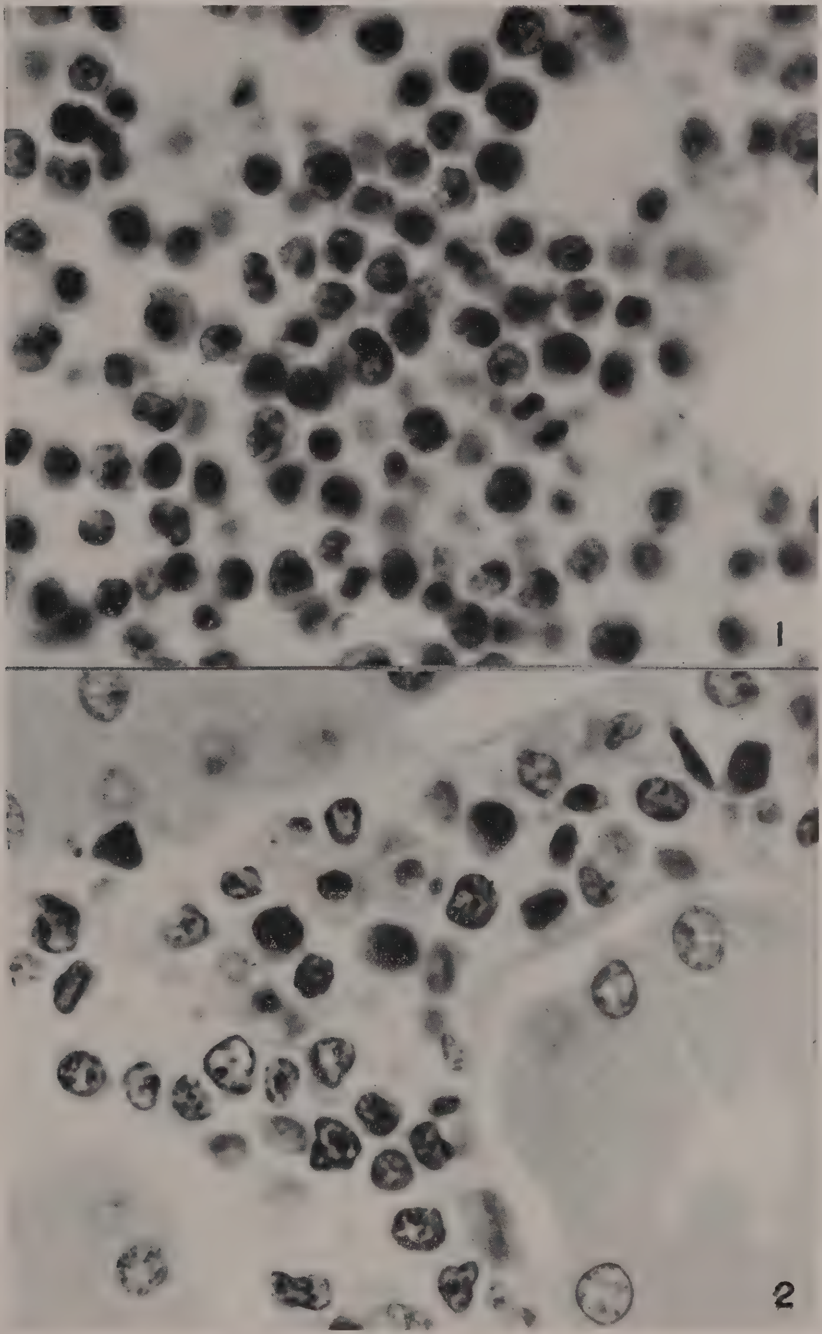

PLATE II

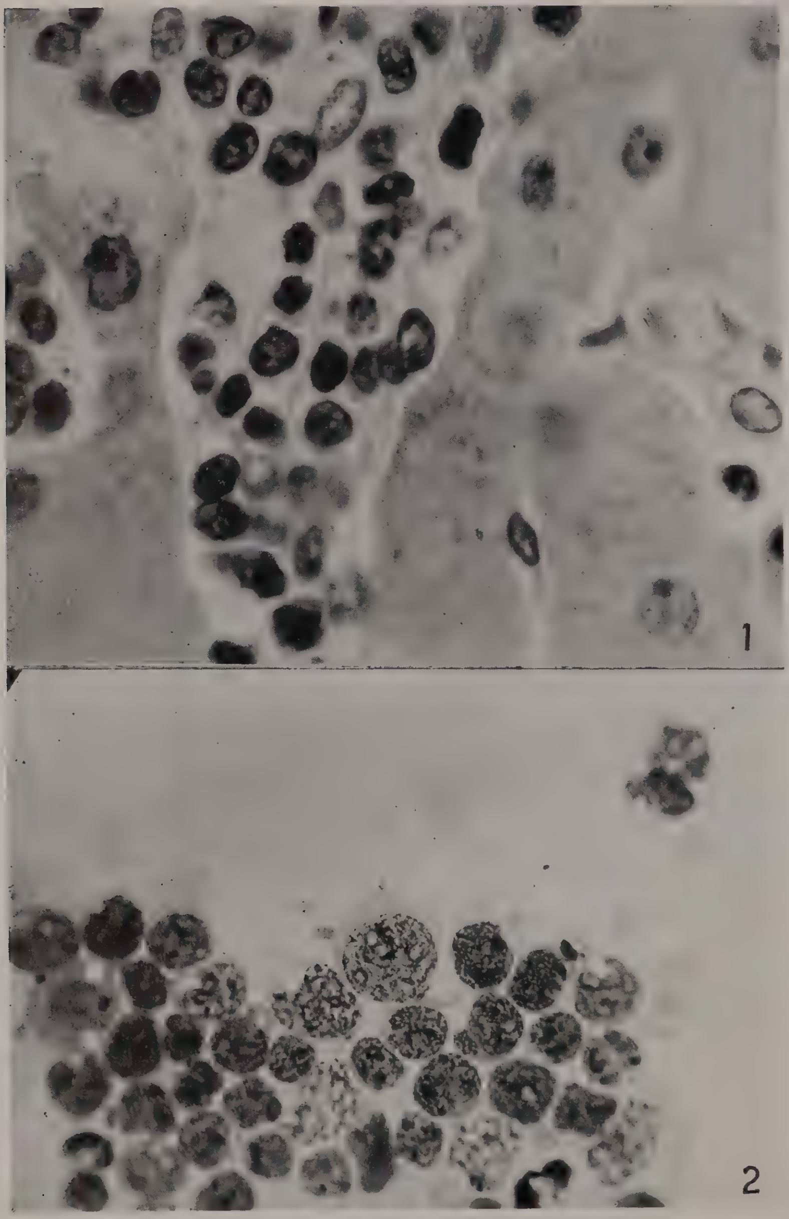

PLATE III

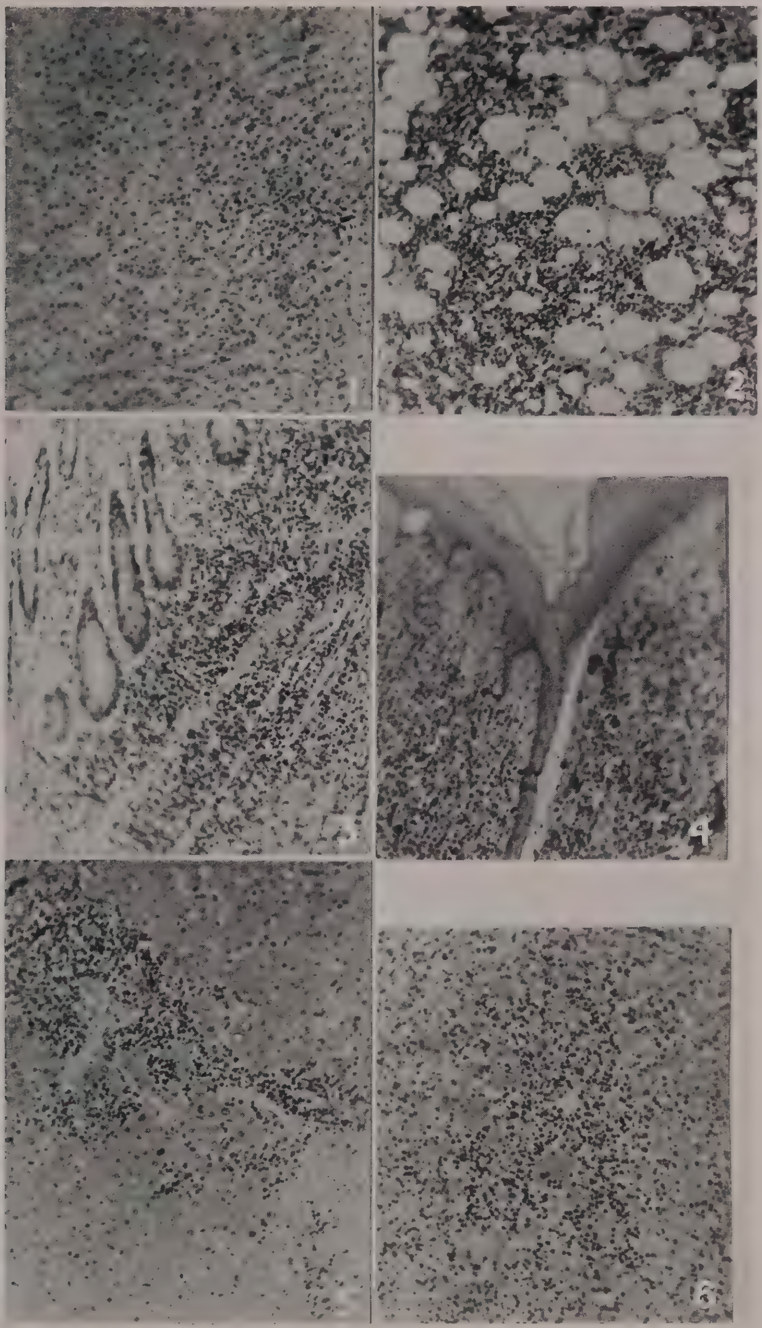

PLATE IV

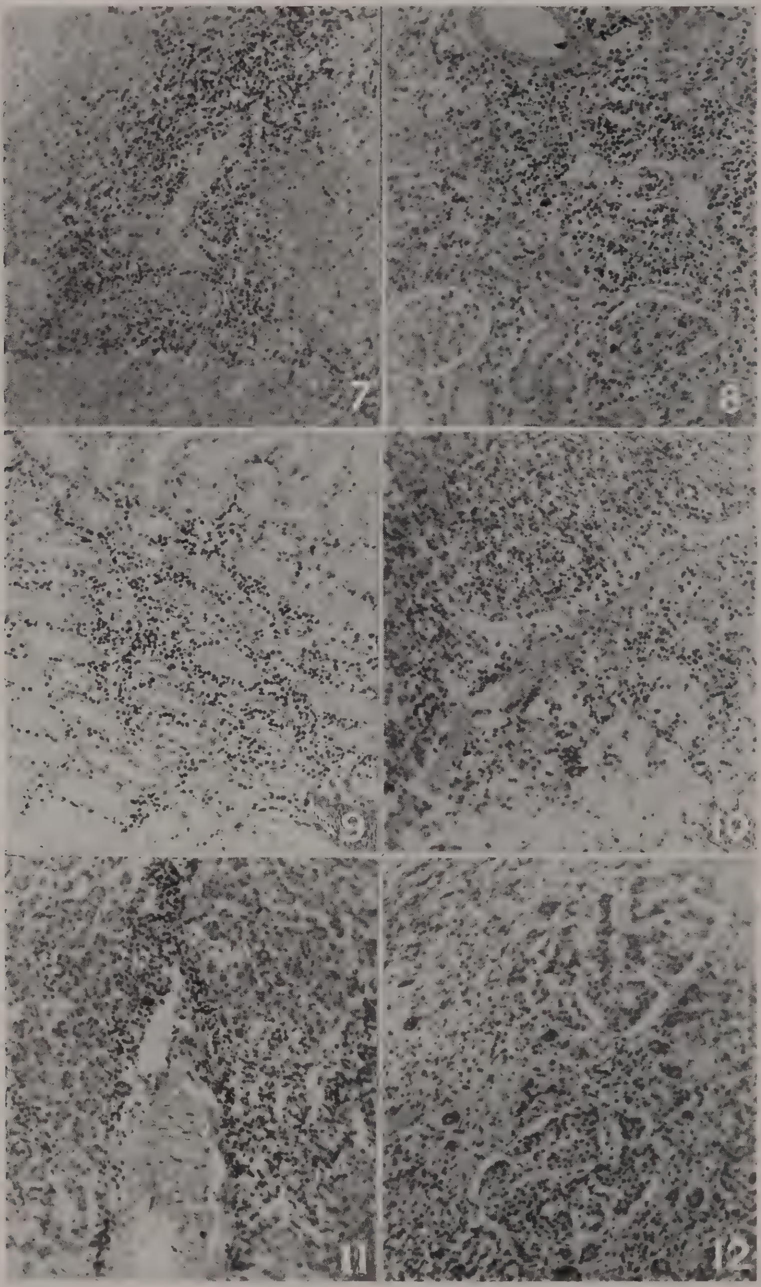

PLATE V

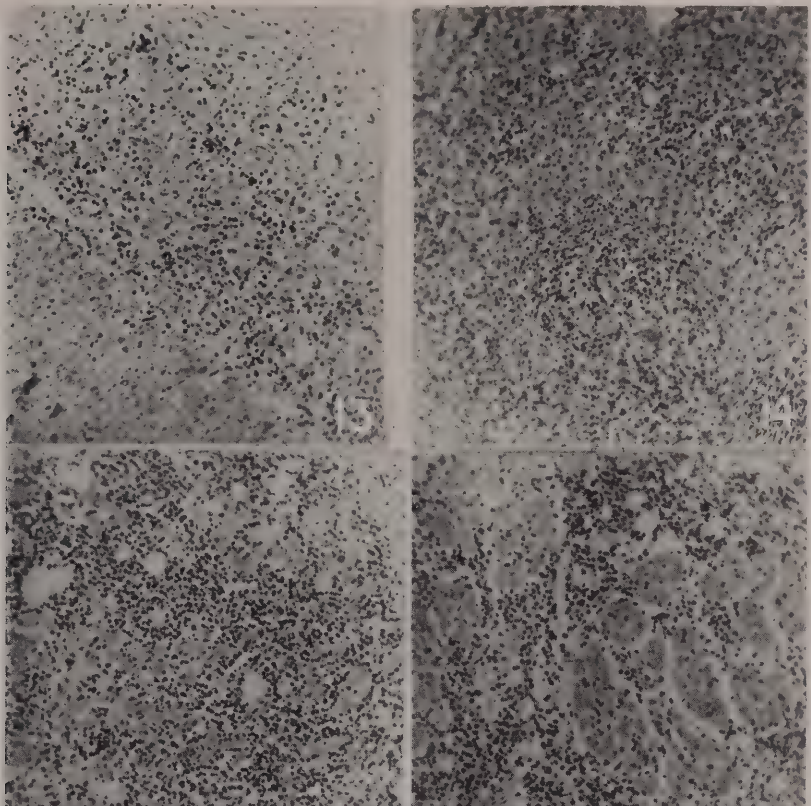

PLATE VI

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SECTION IV

SPINAL ANAESTHESIA WITH STOVAINE AND ADRENALIN

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This paper does not deal with a new development in the art of surgery, as the great contributions of Corning, Quincke, Tuffier, Forgue, Bier, La Filliatre, Jonnesco, and others provide the most convincing literature on the subject, with a maximum of technical details; but, nevertheless, small contributions added to those already reported may serve a useful purpose.

The number of surgical operations performed under spinal anesthesia, in this Hospital, has exceeded two thousand since 1915. Most of these should be credited to my predecessors; and especially to Dr. Edward B. Ross, who introduced this method in Quirigua Hospital.

This paper is based on eight hundred spinal anesthesias given by the writer, who has performed practically all types of surgical interference below the diaphragm.

STOVAINE, ADRENALIN, AND TRENDELENBURG POSITION IN THE INDUCTION OF SPINAL ANAESTHESIA

Stovaine.—This salt, in proper solution for therapeutic use and injected into the spinal canal, produces spinal block anaesthesia. It acts on the afferent sensory nerves by the affinity of anaesthetic salt to nerve lipoid substance, and the physiochemical reaction is produces.

The anaesthesia is rapidly induced; and, after the patient is under anaesthesia, any change of position on the table, or the withdrawal of spinal fluid, does not influence the effect of the anaesthetic to any noticeable degree.

Besides, the anaesthetic action of Stovaine on the afferent sensory nerve fibers, by blocking and interrupting also the impulses of the vasoconstrictor action of the fibers of the splanchnic nerve that supplies the vasoconstrictor action of the abdominal viscera, produces a flow of blood to the abdominal viscera at the expense of other organs, specially the brain, resulting in a more or less marked fall of blood pressure and cerebral anaemia.

The irregular cribriform membranae (*ligamentum denticulatum*) separates the anterior and posterior compartments where anterior vasoconstrictor and posterior sensory roots are located respectively. This ligament shows, as its name "cribriform" implies, a certain number of perforations near the point where puncture of the ligamentum subflavum is made by the entrance of the needle into the arachnoid space, and the diffusion of anaesthetic solution is bound to get into the anterior compartment, producing more or less action over the vasoconstrictor fibers.

If, by faulty technique in giving the anaesthetic, the needle is pushed farther than the posterior arachnoid space, separating nerve bundles of cauda equina and entering the anterior compartment, and the anaesthetic solution is injected there; more anterior roots will be affected, and more blocking of vasoconstrictor impulses to these roots will occur and the disagreeable sequelae mentioned later may result.

Adrenalin.—The hormone adrenalin has a dual effect, producing stimulation of the sympathetic nerves and exerting a powerful constrictor influence upon blood vessels in the viscera supplied by the splanchnic system and the musculature innervated by the sympathetics. It also influences carbohydrate metabolism.

The action of adrenalin upon the vasoconstrictor nerve endings of blood vessel walls when nerves are cut, has been explained and demonstrated by Riesman. Through its vasoconstrictor stimulation, adrenalin raises blood pressure; and, when blood pressure is already high, the vasomotor system is more sensitive to adrenalin action (O'Hare).

Adrenalin can be administered in many ways, according to the urgency of the case or convenience to the operator—intra-spinally, subcutaneously, intravenously, by rectal injection, orally or, in emergency, directly into the heart. As a routine aid in spinal anaesthesia, I give it subcutaneously.

Gruber came to the conclusion that adrenalin undoubtedly exerts some specific action upon fatigued muscles. Macphail has demonstrated its beneficial effect in the control of emesis due to malaria infection. The writer has demonstrated its value in the diagnosis and treatment of stubborn malaria cases, based on the action of adrenalin upon haematopoietic viscera. The vasoconstrictor influence of adrenalin on the spleen seems to produce constriction of the organ with expression of the hidden malaria parasites into the peripheral circulation.

In spinal anaesthesias, adrenalin exerts a vasoconstrictor action which corrects the vasodilatation produced by the action of stovaine upon the vasoconstrictor fibers of spinal nerves; and thereby prevents a drop in blood pressure, cerebral anaemia and its sequelae, faintness, vomiting, etc., etc.

Trendelenburg Position.—A supine position on the operating table or the bed, inclined at an angle of 45 degrees so that the pelvis is higher than the head. Action of stovaine on the splanchnic nerves produces a more or less marked blocking of vasoconstrictor stimuli or abdominal vessels, resulting in vasodilatation.

This dilatation of vessels in the abdominal viscera produces an influx of blood to this area, which Koster and Kasman aptly compare to an internal haemorrhage. As a physical law; blood pumped by the heart, will follow the course of the relaxing arteries, and the return of venous blood to the heart is proportionately retarded, because the elastic condition of the already relaxed arteries, is the force behind the flow. Dilatation of all or part of the splanchnic vessels is the cause of the failure of the blood supply to the brain, and the consequent cerebral and bulbar anaemia or ischemia. Deficiency in the amount of blood returning to the heart, and the constant fall of blood pressure, do not permit the heart to pump enough blood to the brain to maintain normality.

Trendelenburg position in spinal anaesthesia is based on a simple physico-mechanical law, and encourages the blood drainage from the engorged abdominal vessels by reason of gravity, and consequently improves the heart action and insures the cerebral circulation, avoiding or relieving cerebral and bulbar anaemias.

TECHNIQUE

Patient should have the stomach empty when possible, but in emergency cases a full stomach does not contraindicate spinal anaesthesia. Depending on the age and weight of the patient and the character of the operation, a half c.c. to two c.c., of the following solution, can be injected: stovaine 0.050, glucose 0.050, per cubic centimeter. We use the ampoules of two c.c. solution, (Stovaine Billon) prepared by Poulenc Freres, Paris (France). A child of 10 to 13 years of age, and with a weight of 75 to 90 lbs., requires one c.c. of the solution; and this gives an average of 30 to 40 minutes of anaesthesia. A patient of 14 to 18 years of age, and from 90 to 125 lbs. of weight, is anaesthetized for 40 to 50 minutes with one and a half c.c. of solution. Adults of 140 lbs. and over are anaesthetized from 40 to 80 minutes with 2 c.c. of solution.

Adrenalin is given subcutaneously (5 to 15 minims of 1:1000 solution depending on the age of the patient) immediately after the stovaine is administered; and, when necessary, the dose can be repeated 2 or 3 times. I have given 30 minims in one dose intravenously or directly into the heart, with surprisingly good results, in cases of shock and cardiac failure.

The anaesthesia of the skin puncture site is done with 2 or 3 c.c. of one per cent solution of novocaine.

I place the patient on the operating table in lateral decubitus, on the left side and with forced flexure of knees and hips to the abdomen; and with the head and shoulders bent forward, producing a maximum curvature of the spinal column.

An oblong field, 10 inches long by 6 inches wide and having as its center the 3rd to 4th lumbar vertebrae interspace, is prepared with tincture of iodide and alcohol.

The surgeon's hands should be already sterile, so that he can put on his gloves and start the operation as soon as anaesthesia is complete.

The field cleansed should be sufficiently large to allow the surgeon to keep his hands free from dirty areas.

The left thumb localizes the spinous processes of the 3rd and 4th lumbar vertebrae, and novocaine solution is injected to anaesthetize the skin in that particular region.

An 18 gauge platinum needle, $3\frac{1}{2}$ inches in length, is placed between the right index and middle fingers; the head of the needle is placed against the palmar region of the right thumb; and the point lies between the left thumb and the right ring finger. As the left thumb is localizing the processes spinosus of the 3rd or 4th lumbar vertebrae, the needle is introduced slowly into the interspinosus space, guided by the left thumb, until one feels the sensation of the needle passing into the arachnoid space. Experience gives that characteristic feeling to the fingers. The sharp oblique lumen of the needle is directed face upward, to permit free drainage of the spinal fluid, as soon as the needle enters the arachnoid space. If drainage is not free, a rotating movements of the needle may help. A needle with an obturator is best. All these details may sound elaborate; but they save many needles; and one can calculate on using one needle for 500 anaesthesias, if proper care is exercised.

I allow approximately three times as much spinal fluid to escape as the amount of anaesthetic solution I propose injecting. After the necessary amount of spinal fluid is withdrawn, a 5 c.c. syringe containing the stovaine solution is adapted to the needle; and spinal fluid is aspirated. At times the fluid runs into the syringe by its own pressure, pushing the piston up. I draw into the syringe an amount of spinal fluid which is approximately equal to the amount of anaesthetic solution; and, when that particular amount has been withdrawn, we get a slightly milky color in the mixed fluids. Then the whole is injected with gentle pressure.

I make the puncture at the 3rd lumbar space, for stomach, liver, spleen, and kidneys; and at the 4th space for the rest of the abdomen, genitourinary tract, and lower extremities.

The adrenalin solution is injected subcutaneously in part of the same sterile field, immediately after withdrawal of the spinal needle; and the patient is placed immediately in the Trendelenburg position.

Any talk or undue noises during the operation should be avoided, so that the patient will not be excited or annoyed.

The patient may be kept in the Trendelenburg position for 3 or 4 hours after operation, which can be accomplished by raising the foot of the bed. This is usually not necessary; and the patient can be placed safely in the Fowler's position, if desired.

For transportation of the patient in the Trendelenburg position, a wooden wedge covering half the length and the whole width of the carriage (wheel stretcher), with the base at the foot of the stretcher, will give satisfactory results.

CLINICAL DISCUSSION

In all of my cases, I have had none of the disturbances which have been reported by many of the writers on the subject, such as cephalalgias consequent to spinal puncture, paralysis of lower extremities, paralysis of the bladder, retention of urine, sudden dangerous fall of blood pressure soon after anaesthesia, etc. I have not lost a case due to the anaesthetic—as a matter of fact, only one of my cases died on the operating table; and that death was due to acute haemorrhage and shock from traumatic rupture of the spleen.

A very few cases developed a mild headache after the operation with spinal anaesthesia; and all were relieved by five to ten grains of aspirin. These were not sufficiently severe to be considered as cephalalgia following spinal puncture.

Retention of urine seldom needs catheterization; and, in my cases, it has never lasted more than 24 hours. I have noticed that the few cases of retention of urine which I have had, developed in cases who, for one reason or another, received generous doses of morphine. The only case in this series that had serious urinary disturbances, was an unmarried lady 40 years old, with a very nervous and excitable temperament. She was operated for chronic appendicitis and an ovarian cyst of long standing; and, after voiding normally for two consecutive days after the operation, she developed a paroxysmal attack of complete anuria which lasted two days and was repeated three times within fifteen days. I believed her condition to be hysteric paroxysmal anuria. I re-examined the patient about ten months after her discharge from the Hospital, and found that she was in good condition and enjoying good health.

With my technique, in cases which have had a drop in blood pressure of 5 or 10 mm. of Hg., it has been easily controlled without any risk to the patient.

It appears that the relative and ephemeral fall of blood pressure, after making a spinal puncture, withdrawing a therapeutic amount of fluid, and injecting therapeutic doses of any anaesthetic solution, is a normal physiological reaction of the nervous and the circulatory systems. Control and maintenance of normal blood pressure depends on the surgical judgement of the operator and the careful supervision of technique.

Some writers have discouraged the use of spinal anaesthesia on the grounds of frequency of unpleasant sequelae; and brief comment concerning some of these may be of interest.

Cephalalgia is reported as one of the most common complications in spinal anaesthesia. These acute headaches are almost certainly due to hypertension of brain blood vessels; and is a reaction which follows the hypotension produced by blocking fibers of vasoconstrictor nerves at the time of induction of the anaesthesia. Hypertension, when very markedly and suddenly induced at the time that the circulatory system reassumes its equilibrium in the cerebral circulation, causes a congestion of the meningocerebral tissues. The same state of affairs occasionally causes cephalalgia (post-anaesthetic), when we elevate the patient's head and thorax before circulation has been normalized.

When no vasoconstrictor nerves are affected at the time of inducing the anaesthesia, or even when some fibers are blocked; if adrenalin is given and the Trendelenburg position is maintained as a routine in spinal anaesthesia, the percentage of cephalalgias is nil.

Retention of Urine.—Retention of urine has occasionally occurred in cases in which morphine has been given for some reason—e.g., to a very nervous or excitable patient or for severe pain.

In this series, retention has not lasted for more than 24 hours; and in only four cases was catheterization of the bladder necessary. In each of the four cases, two males and two females, catheterization was only necessary once.

Paralysis of the Bladder Sphincter and of Lower Extremities.—In cases when such sequelae have resulted, they were probably due to lack of surgical judgment and faulty surgical technique—e.g., puncture of a diseased cord; punctures in infants, without correct localization of the spinal cord; high punctures, etc., etc. In the present series of 800 cases no such sequelae were noted.

Faintness, Nausea, Vomiting, and Pseudo-Asphyxia.—These are practically all due to cerebral anaemia, and can be almost certainly avoided by strict adherence to correct technique.

Fatalities.—They are not due to failure of the myocardium nor to primary respiratory paralysis, as the phrenic nerve is not affected with the anaesthesia when given as outlined.

Koster and Kasman's report shows the action of spinal anaesthesia for surgical interferences above the diaphragm. They include operations up to the face and vault, blocking sensory impulses without interfering with motor roots. They operate on empyema of the pleura with costotomy, securing a calm respiratory action.

The only cause of fatality in spinal anaesthesia which I can visualize is from cerebral and bulbar anaemia. No case in this series gave any indication of grave symptoms from the use of stovaine.

Contraindications.—The contraindications to spinal anaesthesia are: hypotension due to organic heart disease, diseased cord, infection at the site of the puncture, and exceeding nervousness. There is also a relative contraindication in children.

I have had cases with acute primary anaemia and extremely low blood pressure following trauma, in which surgical interference has been done with stovaine-spinal-anaesthesia and adrenalin with marvelous results. A few examples are: amputation of lower extremities due to railroad accident; intervention for rupture of tubal pregnancy; gun-shot wounds involving liver, spleen and kidneys; and machete or knife wounds of abdominal organs. This shows that low blood pressure is not a contraindication for spinal anaesthesia, unless it is due to organic cardiac disease. My belief in this matter goes further: I believe that in this type of case the anaesthesia of choice is the spinal block. The induction is quicker, avoiding the excitement stage of inhaled anaesthesia; and it insures abdominal silence, which is very helpful in any operation involving a bloody abdominal cavity.

ADVANTAGES OF SPINAL ANAESTHESIA

Operative shock is practically abolished; no nausea or post-operative vomiting is present, as in inhaled anaesthesia; bronchial and renal complications are avoided; complete abdominal silence is insured; and the patient himself helps the surgeon by answering any question, coughing to bring out a hernia, etc., etc.

Induction of anaesthesia is rapid; and when this method of anaesthesia becomes well known in a community, the people get greater confidence in the surgeons and the usual human fear of any surgical operation is somewhat alleviated. The patient can have water or other liquid by mouth at the time of the operation or immediately after. It is the ideal anaesthesia in old age, and in anaemic and cachectic patients. The necessary amount of anaesthetic is given at once, and in one single dose, for the different surgical procedures and the different lengths of time. The patient can be placed in any desired position immediately after the operation, as he is fully conscious and does not use unduly his voluntary muscles. No special nurse is necessary at the bed-side of the patient; and the surgical team is reduced in number, as no anaesthetist is necessary. In long operations, where inhalation of ether is called for towards the end, a few drops keep the patient quiet without getting him into an excited state. It is the cheapest form of anaesthesia, as the approximate cost is only ten cents for the ampoule of stovaine, about three cents for fifteen drops of adrenalin solution, and three cents for 3 c.c. of one per cent novocaine solution.

CONCLUSIONS

1. Spinal anaesthesia, when perfectly induced, is a harmless anaesthetic.
2. Stovaine, adrenalin, and the Trendelenburg position are the choice combination.
3. It is the cheapest anaesthetic known, costing approximately sixteen cents per anaesthesia.
4. Important advantages are obtained by the combination outlined in this article.

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RECTAL ANAESTHESIA WITH AVERTIN IN TETANUS

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A 25-year-old Colombian mestizo was admitted to the Hospital on September 11th, 1931. Two men carried the patient into the ward, holding him by the neck and the heels.

History.—The patient gave a history of three days of illness, which began with painful cramps in the abdominal muscles. These were followed in rapid succession by similar painful sensations in the jaws, the thoracic muscles, and the extremities; until finally he became, as he expressed himself, "as stiff as a board." Defecation and voiding had become almost impossible during the 24 hours preceding his admission. Upon further questioning, he admitted having manipulated, with his pocket knife, the ingrown nail of his right great toe four days previous to his illness.

Physical Examination.—The patient was a well nourished and strong young man, who lay in a state of general rigidity in his bed. Speech and the swallowing of food and water were very much impaired by an intense trismus. There was a pronounced stiffness of the neck and of the muscles of the back and legs, resulting in a distinct opisthotonus. The abdomen was of a board-like hardness; and the tonus of the arms was highly increased. The breathing was shallow and rapid, and frequently interrupted by diaphragmatic cramps. Addressing and touching the patient increased the general tonus and produced clonic cramps. At the right great toe, near the nail bed, a bluish discoloration of the skin was seen. Otherwise, a superficial general examination revealed nothing unusual in the general condition—either externally or internally. The temperature and pulse were normal on admission; the urine was free from pathological findings; and the blood was negative for malaria, and with a hemoglobin estimate of 85%.

Diagnosis.—Tetanus.

Prognosis.—In view of the short incubation period and the time which had elapsed since the patient came for specific treatment, the prognosis was deemed very serious; although we see in the tropics more recoveries from serious cases of tetanus than in the temperate zone.

Therapy.—The therapeutic procedure was as follows: (1) opening the site of the entrance of the infection; (2) tetanus antitoxin in large doses; and (3) symptomatic treatment, emphasizing rest and sleep.

RECTAL ANAESTHESIA WITH AVERTIN

Rectal anaesthesia with Avertin (tribrometanol), which has been widely employed in surgery in Europe and America during the past four years, found its first application in 1927 by Laewen, who produced prolonged anaesthetic sleep in a case of tetanus. The favorable reports which followed the first observation, induced the writer to employ Avertin in the case which is presented here.

Course of Treatment.—The patient received his first Avertin enema (6 grams, in 200 c.c. of water) at 3:30 p.m. on the day of his admission. Five minutes later he was asleep. The site of the entrance of the infection was treated; and a lumbar puncture was performed, and 10,000 units of tetanus antitoxin were injected into the spinal canal. He received an additional 10,000 units in the cubital vein, and 1,500 units intramuscularly in the right leg. He was catheterized and received a sponge bath. During all these procedures the patient was in a rather deep anaesthetic sleep. There was still some rigidity of the extremities and the abdominal muscles. He slept for nine hours, during which he had occasional clonic contractions of short duration. His breathing was free, and the pulse was strong and regular. Upon awakening, he received a hypodermic injection of morphine hydrochloride $\frac{1}{4}$ gr. and atropine $\frac{1}{150}$ gr. Luminal, $1\frac{1}{2}$ grs., were given by mouth. He continued to be in a state of drowsiness, during which time the cramps were less frequent and milder than they were the day previously. He took liquid food, with little difficulty. A similar procedure was followed during the next five days, and a steady improvement was observed. (The details of the course of the disease during the first week, and the therapeutic measures adopted, can be seen in the accompanying chart.)

The patient received a total amount of 51,000 units of tetanus antitoxin; 40,000 units of which were given intraspinally. A total amount of 30 grams of Avertin was given, in six anaesthesias, during the first six days. The duration of deep anaesthetic sleep varied between eleven and four and one-half hours, the average being seven and one-half hours. This was followed regularly by a period of light sleep and drowsiness, lasting about four hours. From the second day, the patient was practically free from attacks during twelve out of each twenty-four hours. After the first week, he was considered as convalescent. He recovered completely, and left the Hospital six weeks after his admission.

No untoward effects on the circulatory or respiratory systems, or the kidneys, liver or rectum, followed the administration of Avertin.

COMMENTS

The first report of the use of Avertin in the symptomatic treatment of tetanus was made by Laewen, in 1927. (Zentralblatt fuer Chirugie, 1927, Nr. 38, S. 2370.) Since that time, 18 more cases have been reported in the German literature. Including this report, a total of 20 cases with 8 deaths (40%) have been recorded. If we take into consideration only those cases in which the incubation time is known to us; we find a mortality of 41.7%, with an average incubation period of 9 days. This compares favorably with the mortality rate of previous observers: Anders and Morgan, in the Journal of the American Medical Association, 1905, reported a mortality of 48.8% with an incubation time of two weeks;

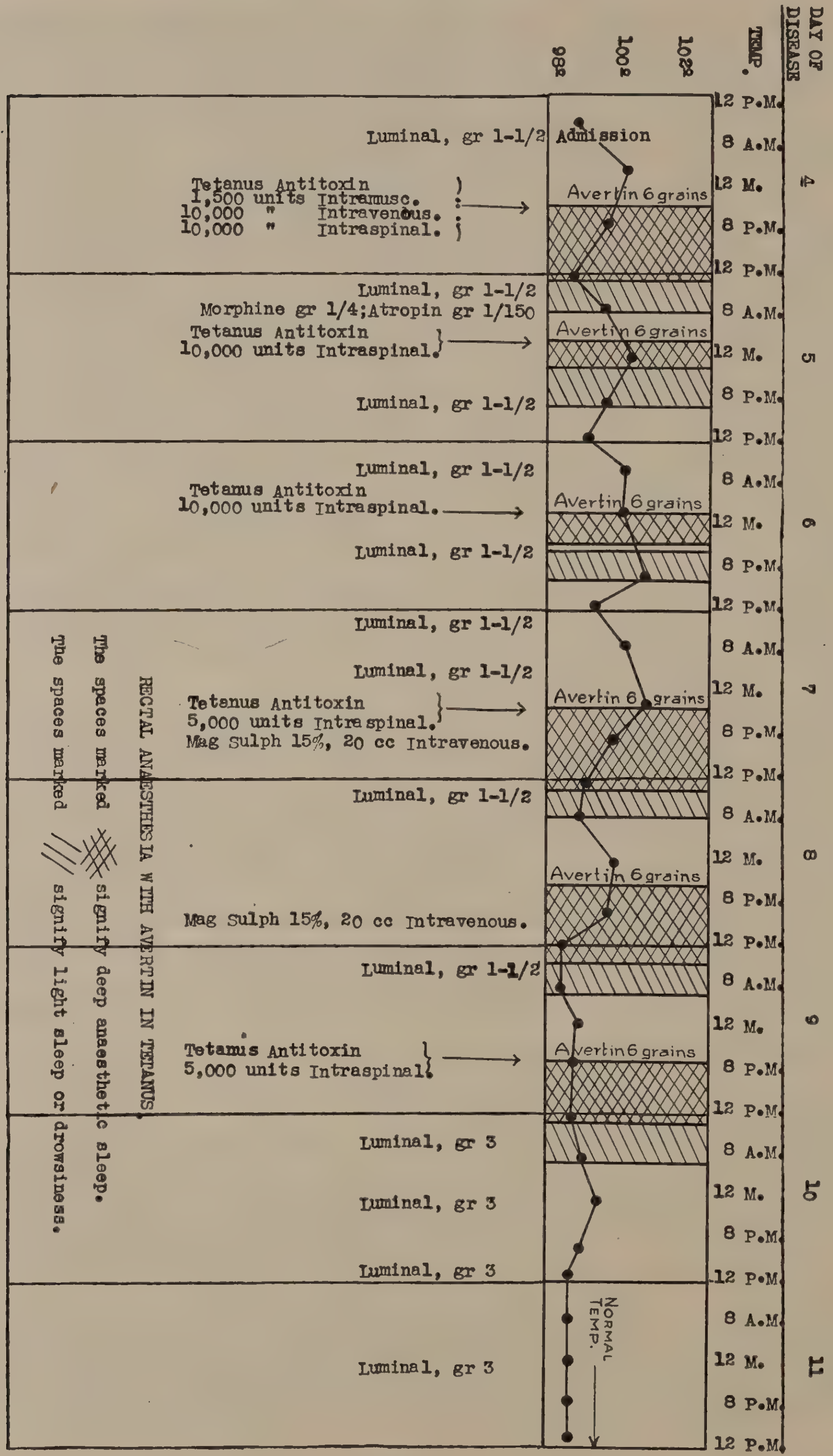
DAY OF DISEASE
TEMP.
98°
100°
102°
4
5
6
7
8
9
10
11
12 P.M.
8 A.M.
12 M.
8 P.M.
Admission
Avertin 6 grains
Luminal, gr 1-1/2
Tetanus Antitoxin
1,500 units Intramusc.
10,000 " Intravenous.
10,000 " Intraspinal.
Morphine gr 1/4; Atropin gr 1/150
Tetanus Antitoxin
10,000 units Intraspinal.
Tetanus Antitoxin
5,000 units Intraspinal.
Mag Sulph 15%, 20 cc Intravenous.
Luminal, gr 3
NORMAL TEMP.
RECTAL ANAESTHESIA WITH AVERTIN IN TETANUS.
The spaces marked ▩ signify deep anaesthetic sleep.
The spaces marked ▨ signify light sleep or drowsiness.

CHART I

and the cases collected by Sir Davis Bruce showed an incubation period of 13.4 days, with a mortality rate of 57.7%. (Annoted from Stevens, "The Practice of Medicine," 1926.)

Two outstanding features in the observations of the authors who employed Avertin repeatedly at short intervals were: (1) the absence of untoward effects, and (2) the complete lack of an acquired tolerance following such practice. Laewen gave his first patient, in the course of 13 days, 20 anaesthesias with a total amount of 154.0 grams of Avertin; and obtained a cure.

Though I do not think it is advisable to increase the individual dose of Avertin beyond a safe limit, which has to be determined according to the patient's weight and general condition; in future I should not hesitate to repeat the anaesthesia more frequently, if such action were indicated.

The employment of Avertin in the symptomatic treatment of tetanus cannot be recommended too strongly. I can only agree with a number of observers who predict that the rectal Avertin treatment of tetanus may outlive the rectal Avertin anaesthesia.

AN AID IN THE TREATMENT OF GENERAL PERITONITIS

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In dealing with cases of general peritonitis, one must take an interest in every aid to treatment which may tend to improve the prognosis in these serious cases. I wish to call to the attention of our surgical readers a treatment used with gratifying results in an apparently desperate case of general peritonitis. It is of special interest, on account of the simplicity of its application and the logical basis for its use when cases of this nature are at a certain stage of development.

It is well known how general peritonitis caused by a ruptured gangrenous appendix, when no life-saving adhesions have been formed, acts after 24 hours. The intestines are often glued together, regardless of drainage of the abdominal cavity; and we frequently find that, in late cases, separating the adherent intestines results in perforations of the walls, no matter how gently the surgeon does his work. Secondary laparatomy is a major surgical interference in such cases; and the prognosis is rendered less hopeful, when one finds a patch of many inches of adherent intestines which are frequently multiple.

In a recent article appearing in a German medical journal, the author described and advocated the use of a method which he had found useful in such cases. Unfortunately, the journal was mislaid and reference is impossible.

The general principle involved is a method of flooding the abdominal cavity with saline solution, and gentle kneading and massage of the abdomen while distended with fluid.

The following case report demonstrates the usefulness of this treatment in certain instances:

CASE REPORT

F. C. de A., 27 years old, Guatemalan, married. A physician in a town 60 miles distant from this Hospital telephoned, on the evening of February 23rd, that he had a case of ruptured appendix, with general peritonitis; and wished to send it to us on the first available train. He advised that, in his estimation, it was a hopeless case. Patient was admitted to the Hospital on February 24th, 1931, at 10:30 a.m., with the following history: She had had a sharp pain in the abdomen 3 days previous to admission, which became worse and finally settled in the lower right quadrant. The abdomen became very much distended. The patient had been constipated; and was complaining of severe headache, anorexia, and profuse vomiting. She had an infant, 7 months old, who was breast fed.

Physical Examination.—Well developed female; fat and very much overweight, but in very poor general condition; sunken eyes; cold perspiration; pulse rate was 132, with poor volume; temperature, 102°F.; tongue, heavily coated. The abdomen was very rigid and distended; and the patient was vomiting. Tenderness was general over the abdomen; but more marked over MacBurney's region.

Laboratory Findings.—Urine: acid reaction; S. G. 1.025; albumin, positive; casts —fine granular, hyaline, and cylindroids; pus ++; uric acid, ++; indican ++. Blood was negative for malaria; white blood cells, 32,750.

Final Diagnosis.—Ruptured appendix, with general peritonitis.

Surgical Procedure.—Operation was performed at 11:45 a.m., under spinal anesthesia with $1\frac{1}{2}$ c.c. of the following solution: stovaine, 0.050; glucose, 0.050 per 2 c.c. solution. Patient was given the routine dose of 12 minims of adrenalin solution (1:1000) hypodermically, immediately after the spinal puncture; and hypodermoclysis of 800 c.c. normal saline solution with glucose. Laparatomy was performed with midline incision, extending from 2 inches above umbilicus to an inch above symphysis pubis. The abdominal cavity contained a large amount of pus, which was generally disseminated. The intestines were much inflamed, and some were already glued together by purulent exudates. The appendix had ruptured in the middle third, and was gangrenous; and the tip was separated from the remainder of the appendix, and adhered retrocaecally. The appendix was removed; and a quantity of 2% mercurochrome solution was applied to all parts of the intestine which could be reached easily. Normal saline solution was used to irrigate the abdominal cavity. Three soft rubber tubes were introduced for drainage—one in the upper part and one in the lower part of the abdominal incision, and one in a stab wound in the right lower quadrant.

The patient was placed in Fowler's position, and given nothing by mouth except cracked ice. Morphine, adrenalin and strychnine were administered as the symptoms indicated.

Post-operative Procedure.—On the day after the operation, the patient's abdomen was still distended and tympanitic; but the vomiting had ceased and she felt more comfortable. The pulse rate was between 112 and 128. The temperature did not go above 100°F. The patient voided normally, but complained of gas pains in the abdomen; and a rectal catheter was introduced. Abdominal drainage was copious and free.

On the second day, her condition was about the same; small amounts of water and sodium bicarbonate were given by mouth; and another hypodermoclysis was administered. The patient still suffered from gas pains; the abdomen was very distended; and there was some dyspnea. An enema was given, without any beneficial results. During the second evening, the patient began to vomit quantities of coffee colored fluid; which continued all night, accompanied by hiccough.

The third day she was worse; the pulse was poor; the vomit had a faecal odor; and no gas or faecal matter could be passed by rectum. A warm normal saline solution of

2,000 c.c. was introduced into the abdominal cavity, through the upper drainage tube; and the lower tubes were closed. When the abdomen was full and distended, it was gently massaged. After a few minutes, the tubes were opened and the saline solution allowed to escape. This treatment was given three times during the day. That night the patient passed some gas by rectum, and a small stool. She still vomited occasionally; and the vomitus contained faecal matter.

The fourth day, two more treatments with saline solution and massage were given; and pituitrin was administered hypodermically. The patient remained in very poor condition. Cardiac tonics were given, and another hypodermoclysis administered. In the evening a very large stool was passed, and she felt much better.

On the fifth day, the temperature dropped to normal; pulse, 96; respiration, 24. Subsequent treatment consisted of daily dressing of the abdomen. Improvement continued, and she had two or three stools daily. Vomiting became less, and gradually disappeared. The drainage tubes were gradually withdrawn, and were entirely removed on the eighth day. Liquid diet was permitted on the tenth day; and the patient left the Hospital on the nineteenth day, in excellent condition.

THE PROGNOSIS FOR LIFE AFTER SPLENECTOMY—CASE REPORT

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Febrile tropical splenomegaly is a rather common disease among the patients who enter our hospital. The most pronounced symptoms are: (1) an extremely enlarged, firm spleen often reaching to the umbilicus, or even down to the pelvic brim; (2) a slight swelling of the lymphatic glands in various regions of the body; (3) irregular temperature; and (4) a certain degree of anemia with a decrease of the number of erythrocytes. Autopsy generally reveals a lobular cirrhosis of the liver.

As no cure is known at present, the prognosis is very unfavorable; and patients die finally of anemia and emaciation, or some intercurrent infection. Arsenic, iron and small doses of quinine improve the condition for a while; but the patients suffering from splenomegaly generally come back to the hospital at intervals of from 4 to 5 months—each time in a worse condition—and at last die of a general cachexia. Several authors have proposed a removal of the spleen to cure this disease; but these patients are seldom in condition for such a serious operation, as there are frequently extensive adhesions of the spleen to either the thoracic wall, the diaphragm, the intestines, or to all of these structures. Apparently for this reason, few splenectomies are performed for tropical splenomegaly; or, at least, few results of such operations are reported.

For three years, until the date of his death, we have had the opportunity to observe the course of an operated case.

CASE REPORT

FIRST HOSPITAL ADMISSION

A. B., Honduranian, male, 28 years of age, was admitted February 5, 1928.

History of present illness.—The patient stated that he had been suffering from an enlarged spleen for three years. Lately he had felt an increasing weakness and was troubled more by the size of the spleen. He had had leg ulcers for 6 months.

Physical examination.—Fairly well nourished but anemic. All glands were somewhat enlarged and indurated. There were a few carious teeth. There was a large, roughly circular ulcer, with a clean base and well defined edges, situated on the lower third of the extensor surface of the left leg. The heart and lungs were apparently normal. The spleen was enlarged and occupied practically the entire abdomen. Its margin was palpable two fingers above the symphysis pubic. The temperature was 99.5°F., by mouth.

Laboratory findings.—Urine, very slight traces of albumin and a few pus cells; bilirubin, negative; stool, uncinaria and trichocephalus; red blood cells, 1,800,000; white blood cells, 11,500; hemoglobin, 70%. Anisocytosis, poikilocytosis and normoblasts were present.

Treatment.—Quinine and Fowler's solution.

Developments.—The patient showed irregular temperature ranging up to 101.5°F. There was a slight improvement during the course of the treatment. The laboratory reports on the 16th day after admission (February 20th) were: hemoglobin, 80%; erythrocytes, 1,920,000; leucocytes, 10,000; small and large lymphocytes, 82%; neutrophiles, 16%; mononuclears, 2%. The patient was eager to be relieved of his large spleen, as its size and weight made it a constant burden to him. On the 27th of February, under ether anesthesia, the spleen was removed. It was adherent to the descending colon; weighed 9 pounds; and showed pronounced hyperplasia of fibrous tissue. The patient continued to run a slight fever for about two weeks after the operation. Several blood counts done after operation gave approximately similar results: hemoglobin, 90%; erythrocytes, 2,600,000; leucocytes, 16,000; small lymphocytes, 32%; large lymphocytes, 5%; monoblasts, 2%; neutrophiles, 61%. A few normoblasts, polychromatophilia and anisocytosis were present. The last blood count, shortly before his discharge from the Hospital, showed an increase of leucocytes to 26,000, without any obvious cause. The patient was discharged as cured on March 25, 1928.

SECOND HOSPITAL ADMISSION

More than 3 years later (June 28, 1931), the patient reentered the hospital. He stated that he had felt healthy from the time of his discharge from the hospital, and that he had worked almost all the time on a banana farm. For the preceding 4 days he had been sick, with fever.

Physical examination.—(June 28, 1931). The patient was fairly well nourished. The eyes were congested; the lips were cyanotic and dry; and the tongue was heavily coated. Singultus was present. Chest: bronchial breathing and crepitant râles were present, and indicated lobar pneumonia in the right lower lobe. Temperature was 103°F.

Laboratory findings.—Stool, uncinaria; urine, slight trace of albumin and a few granular casts; blood: erythrocytes, 3,000,000; hemoglobin, 95%; leucocytes, 45,600; lymphocytes, 4%; neutrophiles, 96%; malaria, negative.

Developments.—Several white blood counts showed an increase of leucocytes up to 55,000. The temperature was irregular. There was a formation of two abscesses in the skin, from which pneumococci were recovered. After recovery from the lobar pneumonia, he developed an acute attack of tertian malaria, which responded promptly to quinine. The patient was discharged on August 1, 1931, with apparently normal lungs and a normal blood count.

THIRD HOSPITAL ADMISSION

He was admitted again three weeks later, in a very serious condition. The heart was dilated; and the pulse was very weak and rapid. The lower lobe of the right lung was consolidated, and there were many rales of different sizes over the lower right chest. The blood, on admission, showed a leucocytosis of 20,000, with 80% neutrophiles. The hemoglobin and red blood count had not changed since the previous admission. The patient developed an empyema and died 18 days after readmission. The autopsy revealed an exudative pericarditis; a large softened area in the lower lobe of the right lung; and a lobular cirrhosis of the liver.

The patient, tho not desperately ill when splenectomy was performed, showed a definite improvement for more than 3 years. He died from lobar pneumonia, with empyema and pneumococcic septicemia; but there was no reason to assume that the splenectomy had lowered the resistance of the body in its struggle against this infection.

The intention of this paper is to contribute to the knowledge of the prognosis following splenectomy for tropical splenomegaly. With all reservations, it may be said that there is no objection to splenectomy for tropical splenomegaly, as long as the general condition of the patient is fair, and the technical difficulties (such as extensive adhesions to the parietal or visceral peritoneum) are not prohibitive.

THE TREATMENT OF INFECTION OF THE DISTAL PHALANX (FELONS)—REPORT OF FIVE CASES

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Puerto Armuelles, R. of P.

Felons are common among working people in this Division, and often cause considerable loss of time and work. Thus, they are at times a serious problem to the surgeon as well as to the patient. The surgeon is confronted with relatively virulent infections in individuals who are frequently suffering from intestinal parasites, chronic malaria, or syphilis, with the resulting diminished resistance. He is pressed for time by the pecuniary difficulties of the patient, who is alarmed by the prospect of losing a few weeks of work and incurring hospital fees (if not employed by this Company) for a condition which, to his mind, is insignificant. Under these circumstances, the surgeon has to exercise to the utmost his powers of persuasion; and he is often forced to adopt a more radical method of treatment than would otherwise be indicated.

The importance of a definite outline of treatment from the beginning is illustrated by the report of the following five cases:

CASE No. 1

A Jamaican housewife, age 28 years, was first observed on the 20th of July, 1931, with a felon of the tactile area of the right thumb, which had opened spontaneously three days previous and was discharging copiously through a sinus close to the tip of the thumb.

No incision was made; but the abscess cavity was cauterized with carbolic acid, through the sinus, and the patient was sent home with instructions to bathe the thumb in hot saline solution for twenty minutes three times a day and to apply dry dressings during the intervening time. No stools or blood examinations were made; but the patient was markedly emaciated, and was instructed to take four Pink Tonic Tablets a day for a period of one month.

The abscess cavity was irrigated daily with Dakin's solution; and the sinus was kept open by occasional cauterizations with carbolic acid. As the inflammation continued to spread over the entire distal phalanx; twenty days later an incision was made on its lateral side from the root of the nail to the articulation, and the abscess cavity was irrigated from both sides. An x-ray picture, taken 14 days later, showed involvement of the entire bony phalanx.

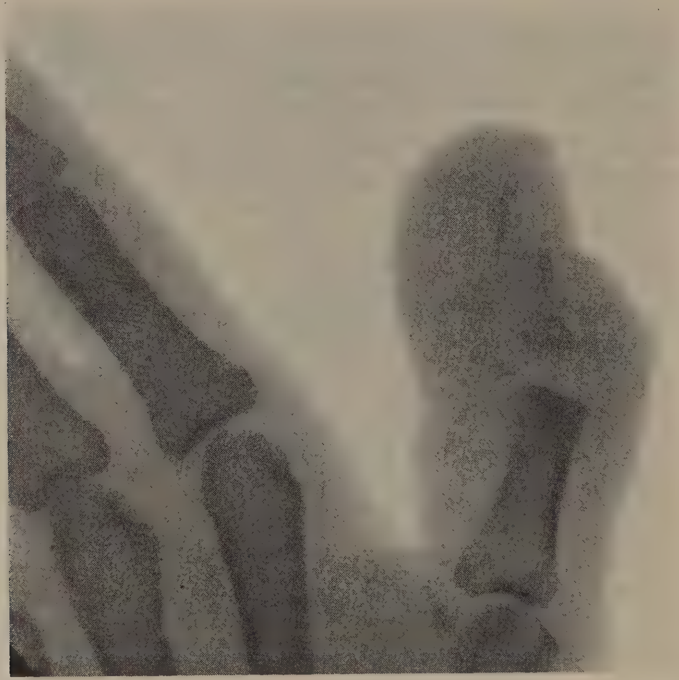

FIG. 1

CASE 1.—PICTURE TAKEN 34 DAYS AFTER TREATMENT HAD BEGUN

The patient was advised to enter the Hospital and to have the sequestrum removed and the thumb properly drained; but she refused admission, and was not seen again at the clinic until three months later when she came for other reasons. At this time, the thumb had regained its normal shape; and was entirely healed, with the exception of the original sinus which was still discharging slightly. A second x-ray picture showed extensive bony regeneration and a small focus of infection in the tip of the bony phalanx.

CASE NO. 2

A well nourished Jamaican cook, age 24 years, employed by the Company, was first seen at the clinic on September 12th; when she complained of throbbing and tenderness of the right thumb. As there was no swelling or evidence of pus, she was advised to apply hot fomentations to the thumb and to return two days later. When she appeared again for treatment; the tip of the distal phalanx was swollen, and presented a soft white area in its center, through which a cross incision was made. The patient continued to work; and, although treated every morning at the clinic, at the end of a week the entire phalanx was swollen and the borders of the incision covered by a fungous granulation. An x-ray examination showed no involvement of the bone. Under block anaesthesia, a horse-shoe incision was made, exposing the anterior surface of the bony phalanx; and the entire wound was cauterized with carbolic acid. As there was marked retraction of the anterior flap, no drain was necessary. The patient was admitted to the Hospital, and treated with hot saline immersions for twenty minutes three times a day; and dry dressings were applied during the intervening time, with the hand elevated and splintered.

On admission, the blood was found negative for malaria and syphilis; haemoglobin was 80%; and the stool examination revealed ascaris and trichuris, for which she was given treatment. She was discharged 12 days from the date of admission and 21 days from the time she was first seen, with the wound completely healed.

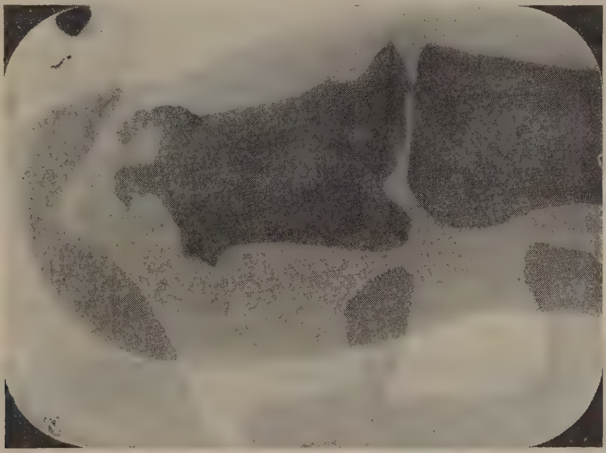

FIG. 2
CASE 1.—PICTURE TAKEN 4 MONTHS AFTER FIG. 1

CASE No. 3

A Costa Rican laborer, 37 years old, was admitted to the Hospital on the 10th of November with a felon of the left thumb. His general condition was apparently good; haemoglobin was 85%; blood was negative for malaria and syphilis; ova of ascaris and uncinaria were present in the feces.

Two incisions were made over the borders of the fluctuating area, and were kept open by a small gauze drain. A hot water bottle was held constantly against the thumb. Two days later, the patient asked to be discharged; and was instructed to bathe the thumb in hot bichloride solution three times a day and to apply dry dressings.

Two days subsequently, the patient returned to the Hospital with a generalized cellulitis of the entire distal phalanx and lymphangitis up to the axilla; and with a temperature of 100°F. The original incisions were widened; and the thumb was treated with hot immersions, and the lymphangitis with lead lotion compresses and splinting of the arm. The patient was purged with calomel and salts, and given aspirin and codeine for the pain. After four days of this treatment, the cellulitis localized to the tip of the tactile area and the temperature became normal. An x-ray picture showed involvement of the entire distal bony phalanx.

Under block anaesthesia, a horse-shoe incision was made anterior to the bone; the an-

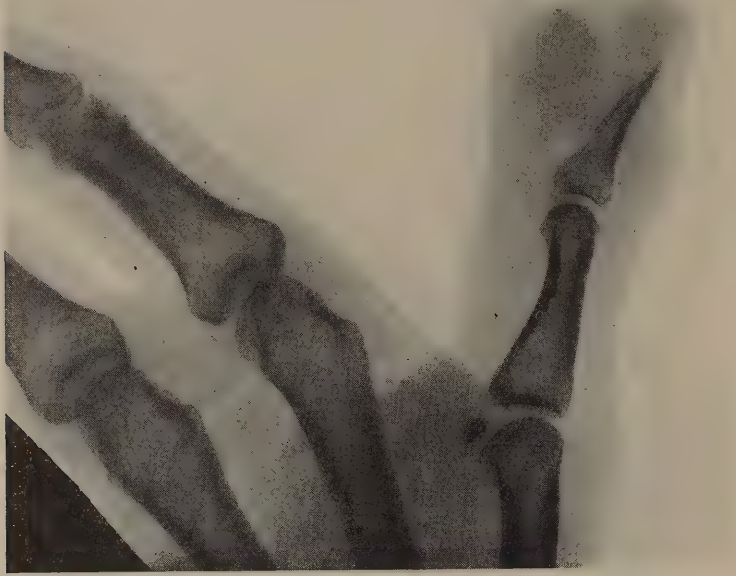

FIG. 3
CASE 3.—PICTURE TAKEN 8 DAYS AFTER FIRST ADMISSION

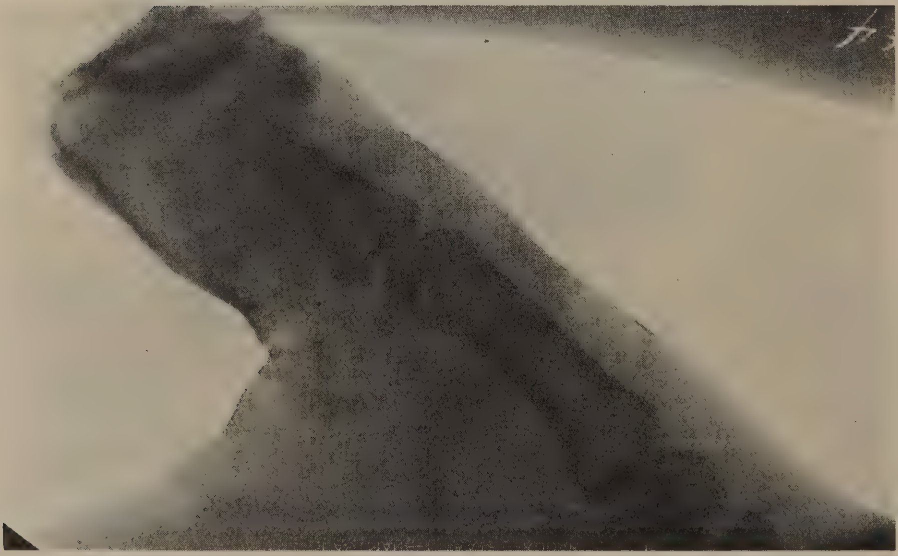

FIG. 4.
CASE 3.—PICTURE TAKEN 13 DAYS AFTER FIG. 3

terior surface of the bone was scraped; and the entire wound was cauterized with carbolic acid. A heavy discharge followed, and the cellulitis spread to the root of the nail. As the patient was reluctant to remain in the Hospital any longer; the distal phalanx was disarticulated, leaving, from an extensive debridement, as long an anterior flap as was possible. The entire wound was again cauterized, and packed with vaseline and gauze; and the patient was discharged, with instructions to return to the clinic every second day for dressings.

Two days later he returned, showing marked inflammation of the proximal phalanx and lymphangitis up to the axilla. A second x-ray examination was negative for bone or joint infection. After the lymphangitis had subsided; under light ether anaesthesia, the proximal phalanx was incised on both sides and through-and-through drainage established. The patient was given another treatment for intestinal parasites; put on a diet rich in proteins and vitamines; and given I. Q. & S. mixture.

He made a slow recovery; but was finally discharged, with the proximal phalanx entirely healed and with normal function, 71 days after his first admission and 56 days after the last operation. This case is particularly interesting, inasmuch as it emphasizes the necessity of hospitalization, the importance of the general condition, the uselessness of carbolic acid in the presence of a virulent infection, and the advantage of ether over block anesthesia.

CASE No. 4

A Nicaraguan laborer, age 26, appeared at the clinic on the 1st of December, with a subcutaneous felon of the tactile area of the left thumb, of 6 days duration. His general condition was good; haemoglobin, 80%; blood, negative for malaria and syphilis; stools, negative for intestinal parasites. There was no evidence of lymphatic involvement; but, as the result of the experience with the other cases, this patient was induced to remain in the Hospital.

Under ethyl chloride anaesthesia, a cross incision was made over the area of fluctuation; and the abscess cavity was cauterized with carbolic acid. In spite of the routine treatment with hot saline immersions and elevation of the hand, the infection spread deeply to the free edge of the nail; and 4 days later the bridge of tissue was divided, exposing the deep sinus. He was discharged with a clean and well-granulated wound, 11 days after the first incision. It is probable that bilateral incisions, with through-and-through drainage from the beginning, would have materially shortened the period of disability of this patient.

CASE No. 5

A Panamanian laborer, age 27, was admitted to the Hospital on January 11, 1932, with a severe infection of the entire right index finger, with cellulitis (especially of the palmar and lateral surfaces of the finger), and with areas of skin necrosis. His general condition was good; haemoglobin, 85%; blood, negative for malaria; ankylostoma, in the stools. An x-ray picture was negative for bone or joint infection.

Under ether anaesthesia, the three phalanges were opened by bilateral incisions which divided all but the tissues over the joints; and through-and-through drainage was established. For 17 days, the patient has now been under the routine treatment of immersions and elevation of the hands; and is showing marked improvement. The temperature has been normal since the day after the operation; and there is every indication to assure us of normal function of the finger.

SUMMARY

The varying results obtained led finally to the following conclusions:

(1) Hospitalization should be enforced, in every case.

(2) Early attention should be given to the general condition of the patient, and syphilis, chronic malaria, and intestinal parasites should be treated, if present.

(3) The surgeon should be on his guard against a tendency to radical treatment; to which he might easily be led by the patient, who often prefers to lose a phalanx rather than sacrifice the time and money involved in obtaining a cure.

(4) Ether anaesthesia is to be given preference—especially in the form of "Etherrausch" (a short period of light general anaesthesia, which is produced by making the patient breathe quickly through a closed mask soaked with ether). For surgical intervention in advanced cellulitis or involvement of the bone, regular ether anaesthesia is called for.

(5) In local treatment, the writer derived the best results from wide bilateral incisions with through-and-through rubber drainage; followed by hot saline immersions for twenty minutes three times a day, and dry dressings during the intervening time with the arm immobilized in extreme elevation.

SYPHILIS OF THE INTESTINE*

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In discussing syphilis of the stomach, Hartwell has stated that a clear-cut distinction must be made between lesions of this organ caused by the spirochæta pallida and lesions which arise from other causes in a person suffering from syphilis. The first is a true syphilitic lesion of the stomach, the latter is not and must not be confused with the first.

In the present discussion the term syphilis of the stomach is used to indicate a lesion which shows pathological changes similar to those in other tissues caused by the luetic virus. This definition, in our opinion, applies not only to syphilis of the stomach but to syphilis of the intestine as well and represents the scientific conception of syphilitic lesions of the gastro-intestinal tract.

Syphilis of the intestine was first described by Monteggia of Milan in 1794 and later by Cullerier in 1854. Warstat in 1913 and Gaucher in 1916 have written extensive articles on congenital intestinal syphilis, while Ceraulo, Campana, and Schmidt have also written on syphilitic lesions of the intestines, both on congenital and acquired forms. The different phases of the disease have been thoroughly discussed and illustrated with case reports in these articles, from the slight enteritic manifestation to the less frequent obstructive lesions associated with encircling ulcers and the tendency to stricture formation.

Oberndorfer states that the gastro-intestinal tract is infrequently the seat of syphilitic lesions, usually gummatous neoplasms.

Brown and Gaither believe that congenital forms of intestinal syphilis obviously occur in early childhood, while syphilitic intestinal lesions of acquired syphilis are tertiary and late manifestations of the disease.

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* This article appeared originally in Surgery, Gynecology and Obstetrics, August, 1931, Vol. LIII, 221–224.

MacCallum says "tertiary lesions of the small intestine are usually localized in the jejunum, or the upper ileum, where they appear as flat elevations of the character of a syphilitic granulation tissue involving submucosa and mucosa. Multiple ulcers are found which extend in the form of rings around the gut, and which in healing may produce strictures." He cites a remarkable example in the Pathological Museum of Columbia University, but says "the condition must be very rare."

Fraenkel, according to Wile, states that he has found only 3 cases of intestinal syphilis in 19,000 postmortem examinations. He says that in his 5 years' experience with luetic patients he has seen no such cases, and adds that the jejunum is the more frequent seat of the lesion than any other portion of the intestinal tract.

Sparman remarks that syphilis of the gastro-intestinal tract has no characteristic features, unless probably nocturnal exacerbations, and calls our attention to the comparative frequency in which cases of supposed malignant disease of the digestive tract have improved under anti-luetic treatment.

PATHOLOGY

There are no gross characteristics, although Gutmann in reporting a case of multiple ulcers of small intestines of syphilitic origin, describes them as circular, entirely enclosing the lumen of the bowel, with flat basis, sharp edges, and somewhat undermined. Rieder, as quoted by Gutmann gives the following characteristics:

1. The lesions may be situated in any part of the small intestine, but are especially frequent in the jejunum.
2. The lesions may be multiple or in separate groups.
3. The lesions have a tendency to encircle the lumen of the bowel.
4. The lesions may cause stenosis.
5. The lesions show uniform consistency.
6. The lesions have nothing to do with the primary ulceration but are a new tissue formation which attacks all the intestinal layers, localizing at any early stage around the blood vessels.

Microscopically the principal characteristics are "round cell infiltration with epithelioid cells and occasional giant cells. The blood vessels show endarteritis and endophlebitis obliterans sometimes being completely occluded, and there is a perivascular infiltration. Miliary gummata are often seen."

The diagnosis of syphilis of the small intestine is obviously very difficult, as the symptoms are not characteristic but vary with the type and location of the lesion. Also, as already stated, intestinal symptoms in a person suffering from syphilis do not invariably mean that he has a luetic lesion of the small intestine. Perhaps the most important point to bear in mind in considering a diagnosis of intestinal syphilis is that obstructive symptoms in patients past middle life do not necessarily mean cancer, in spite of a repeated negative Wassermann. From the surgical standpoint I am going to quote from Riggs who has summarized the subject very satisfactorily.

"In considering the field of surgery in syphilis of the intestinal tract one appreciates Wilmoth's classification according to symptoms, the order of which I am taking the liberty to reverse, believing that by so doing the order of clinical frequency is best represented.

1. Those with nausea, vomiting, and diarrhoea.
2. Those with definite digestive disturbances, associated with pain and distress.
3. Those indicating ulcer or stenosis.

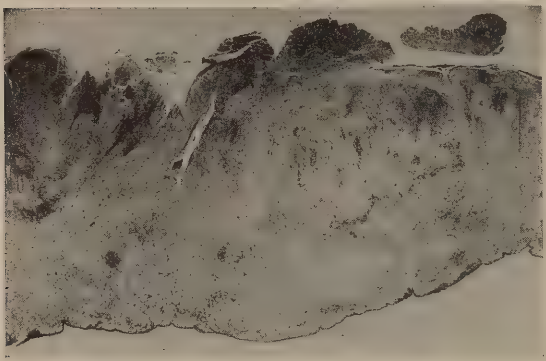

FIG. 1

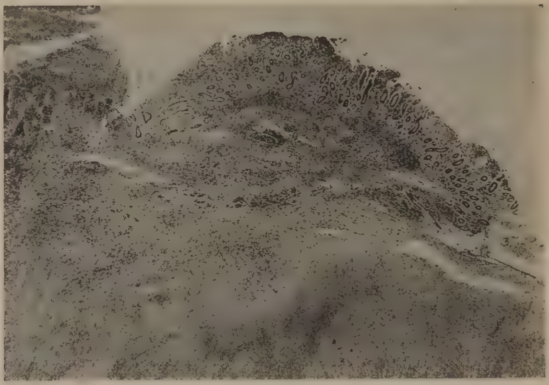

FIG. 2

FIG. 1. SECTION OF MUCH THICKENED JEJUNUM SHOWING SUPERFICIAL AND DEEP ULCERATIONS AND IN THE RIGHT HALF ONE LARGE AND ONE SMALL GUMMA

FIG. 2. FROM ANOTHER SECTION SHOWING PART OF SAME LESION UNDER HIGH POWER. BENEATH THE MUCOSA ARE NUMEROUS GIANT CELLS AND STILL LOWER DOWN THE UPPER PART OF THE LARGE GUMMA

4. Those simulating carcinoma, with palpable tumor.

It is evident that surgery is rarely if ever necessary or justifiable in the first group, but that with each succeeding group its opportunities for good increase, especially if co-ordinated with correct diagnosis and proper treatment.

CASE REPORT

J. A. H., Cuban, 38 years of age, barber by occupation, was first admitted to this hospital on June 14, 1927, with a history of gastro-intestinal disturbances characterized by flatulence, anorexia, and constipation. These symptoms had been present for the past 2 months, becoming gradually worse until 2 days previous to admission, when he was seized by an excruciating pain over the epigastric region, radiating to back and right shoulder, and associated with nausea and vomiting. Jaundice pruritus and clay stools followed the attack. The family history was irrelevant.

Physical examination showed a fairly well developed adult male, poorly nourished, with conjunctiva and skin deeply jaundiced, marked tenderness and rigidity on pressure over the right upper quadrant where a mass could be palpated. The other organs were negative. The leucocyte count was 25,000; polymorphonuclears, 75 per cent. Urine was positive for bile and showed a slight trace of albumin.

The patient who was on the medical service showed gradual improvement under treatment. I saw him for the first time on July 25, 1927, a month and 11 days after admission, when, based on the history, the provisional diagnosis of cholelithiasis was made and operation advised.

Operation. Spinal anaesthesia was used and the abdomen was opened through a Judd oblique incision. The stomach and duodenum were found to be negative. The gall bladder was slightly distended, somewhat thicker than normal, could be emptied easily on pressure, and showed no stones. The cystic and common duct were negative. The head of the pancreas was definitely enlarged, markedly indurated, and was encroaching upon ducts and duodenum. The diagnosis, in our opinion, lay between a chronic pancreatitis and a malignant condition, and a section of the tumor was excised for pathological examination. The abdomen was closed without drainage and the patient was kept in the hospital until August 12, when he was discharged free of jaundice and feeling much improved. The diagnosis of Dr. Mallory then was chronic pancreatitis.

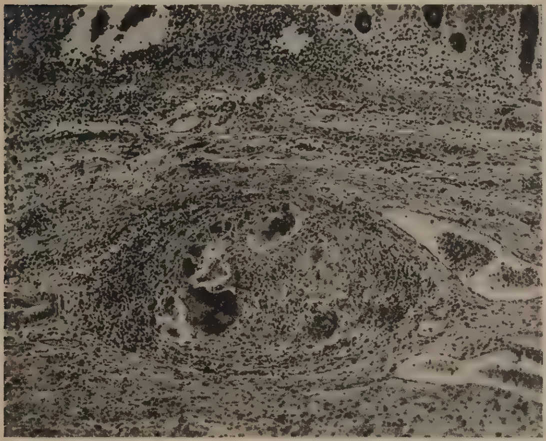

FIG. 3

FIG. 4

FIG. 3. A MILIARY LESION IN THE SUBMUCOSA CONTAINING SEVERAL GIANT CELLS

FIG. 4. A LARGER LESION IN THE SUBMUCOSA WITH THE BASE OF AN ULCER ON THE RIGHT. NUMEROUS GIANT CELLS PRESENT AND ALSO BEGINNING NECROSIS

The patient was readmitted to the hospital June 13, 1928, almost a year after his first admission, with the following history:

From January of this year he began to suffer from gastro-intestinal disturbances, more or less similar to those experienced a year ago, but with the outstanding symptom of marked feeling of fullness in the stomach, even after a small intake of food. He also noticed a dull, more or less constant, pain in the epigastrium with colic-like exacerbations which were only relieved by vomiting, self-induced in many occasions. During the 5 days previous to admission he had become so weak that he had to be brought to the hospital by his attending physician. The vomitus had never shown any blood, but was always bile stained.

Physical examination at this time showed a poorly nourished, anaemic, markedly dehydrated adult male. No signs of jaundice were present. Heart sounds were distinct but rapid. Lungs were negative. The pulse rate was 120; respiration, 22; temperature, 98 degrees F.

The incision of previous operation was soundly healed. No signs of hernia were present. The abdomen was slightly distended. Pain and tenderness could be elicited by pressure over epigastric region. The stomach area was tympanitic.

In view of the critical condition of the patient, no further diagnostic procedure was tried, and with the history obtained a provisional diagnosis of upper intestinal obstruction with dilatation of the stomach was made, and the patient treated as follows: The stomach was thoroughly washed out with solution of sodium bicarbonate. It showed marked bile retention and very few particles of food.

One thousand cubic centimeters of 5 per cent saline glucose solution was given intravenously and 1,000 cubic centimeters of the same solution by hypodermoclysis. Murphy drip was instituted with 10 per cent glucose saline solution. Nothing was given by mouth. On August 16 and 17, the same treatment was given, the patient showing marked improvement.

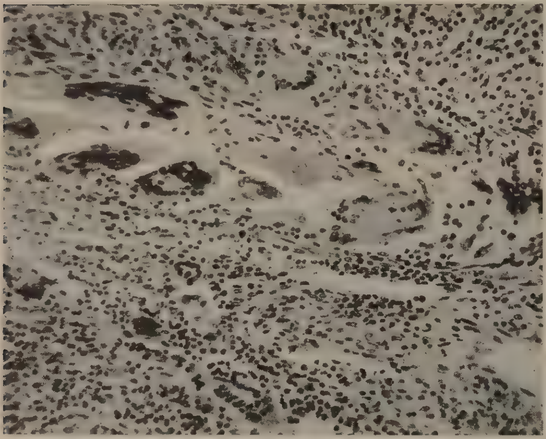

FIG. 5. MANY GIANT CELLS UNDER HIGH POWER. THEY APPEAR IN THE SUBMUCOSA OF FIGURES 1 AND 2

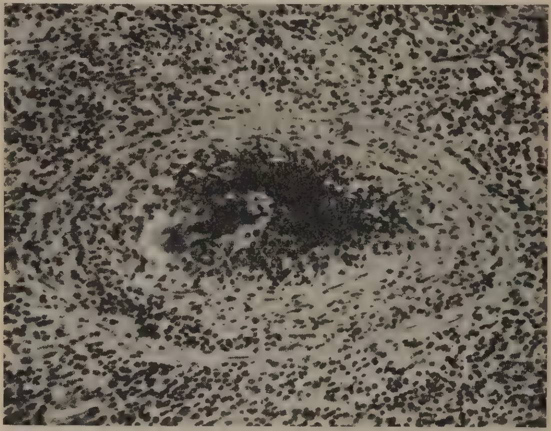

FIG. 6. A SIMILAR LESION IN ANOTHER BLOOD VESSEL. A LARGE GIANT CELL PRESENT

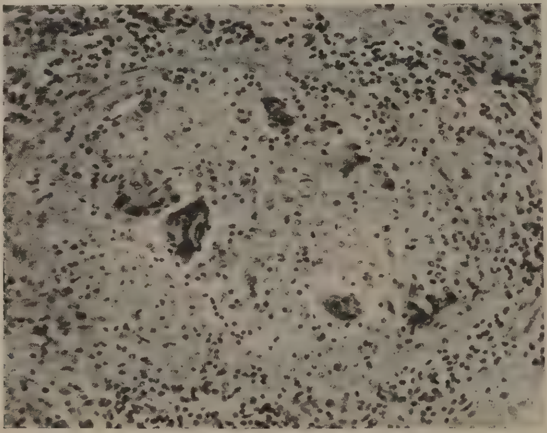

FIG. 7. ANOTHER LESION WITHIN A BLOOD VESSEL SHOWING SEVERAL GIANT CELLS AND NO FIBRIN

On August 18, X-ray pictures were taken and the following was the radiologist's report:

"Stomach markedly dilated, showing practically complete retention, 6 and 12 hours after barium meal. Obstruction apparently present at duodenojejunal angle."

The stomach was immediately washed out and the treatment of previous days repeated. On August 20, an exploratory laparotomy was decided upon.

Operation. Local and spinal anaesthesia was supplemented with ether. A large midline incision was made from the xiphoid cartilage to a point about 1 inch to the right and below the umbilicus. Exploration revealed an indurated, irregularly outlined ulcer about 3 inches in length, involving almost the whole circumference of the small intestine and affecting the terminal end of the duodenum and the first part of the jejunum. It was densely adhered to the posterior wall of the transverse colon with many adhesions surrounding the whole inflammatory area. The diseased portion of the intestine was excised after a laborious dissection, and an end-to-end anastomosis was performed. While exploring the posterior wall of the stomach, we palpated a soft, pulsating tumor about the size of a small lemon, with an apparent thrill which we first thought to be an aneurism of the abdominal aorta, but on further exploration we found it to be a cyst of the pancreas, which was incised, the extra pancreatic portion of it being clipped away with scissors. A Penrose drain was put in and brought to the surface through the gastrohepatic omentum. The gall bladder showed many adhesions and contained several calculi. A cholecystectomy then, in our judgment, was a too radical procedure that would increase the shock produced by the already lengthy operation, so we limited ourselves to draining the gall bladder after we had removed 13 small stones. The stones were soft, of the cholesterol type, and apparently of recent formation. They were not present a year before. The appendix was also removed.

The patient made an uneventful recovery and left the hospital in good condition. The Meinicke reaction for syphilis, after provocative treatment, became slightly positive. He received strong antisyphilitic treatment during his convalescence, and was advised to return for another course of potassium iodide and bismuth.

The histopathological diagnosis of Dr. F. B. Mallory of Boston to whom the specimen was sent was syphilis of the intestine (see photomicrographs).

SUMMARY

A case is reported of syphilitic ulcer of the small intestine. The diagnosis was confirmed histopathologically by Dr. F. B. Mallory. There was in addition a cyst of the pancreas and cholelithiasis. Surgical treatment resulted in complete recovery.

Syphilis of the small intestine is a rare condition. Fraenkel found 3 cases in 19,000 autopsies. Chiari found 8 cases of gastro-intestinal syphilis in 243 syphilitic corpses. Mallory has seen 2 cases in his life time. MacCallum cites a remarkable example in the Pathological Museum of Columbia University, but says "the condition must be very rare."

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EXOPHTHALMIC GOITRE—A CASE REPORT

L. M. Drennan, M.D.

United Fruit Company Hospital

Santa Marta, Colombia

The following case of thyrotoxicosis is reported because of its unusual severity, and the satisfactory results which followed operation and prolonged hospitalization.

A male Colombian, aged 44 years, married, employed as Foreman, was admitted to the Hospital on April 4th, 1929.

History.—The patient had noticed an unaccountable weakness and nervousness, with some cardiac palpitation, about 6 months prior to admission to the Hospital. He stated that, during the strike in the early days of November, 1928, he had felt ill and had retired to his bed; and was asleep when the strikers arrived to set fire to his house. He was awakened by his wife, with the flames of the burning house over his head; and had time to barely escape with her and their only child. They went to the town of Cienaga, which is about 20 miles distant from his home; and he remained there, taking treatment, until the following April. He obtained little or no relief as the result of the treatment which he received during that period. While in Cienaga, his child became ill and died; which caused him intense grief. To this critical emotional crisis, in addition to the fright from the narrowly averted catastrophe in the banana zone at the time of the strike, he attributes the onset of sudden, fulminating symptoms, which up to that time had been of a more insidious nature.

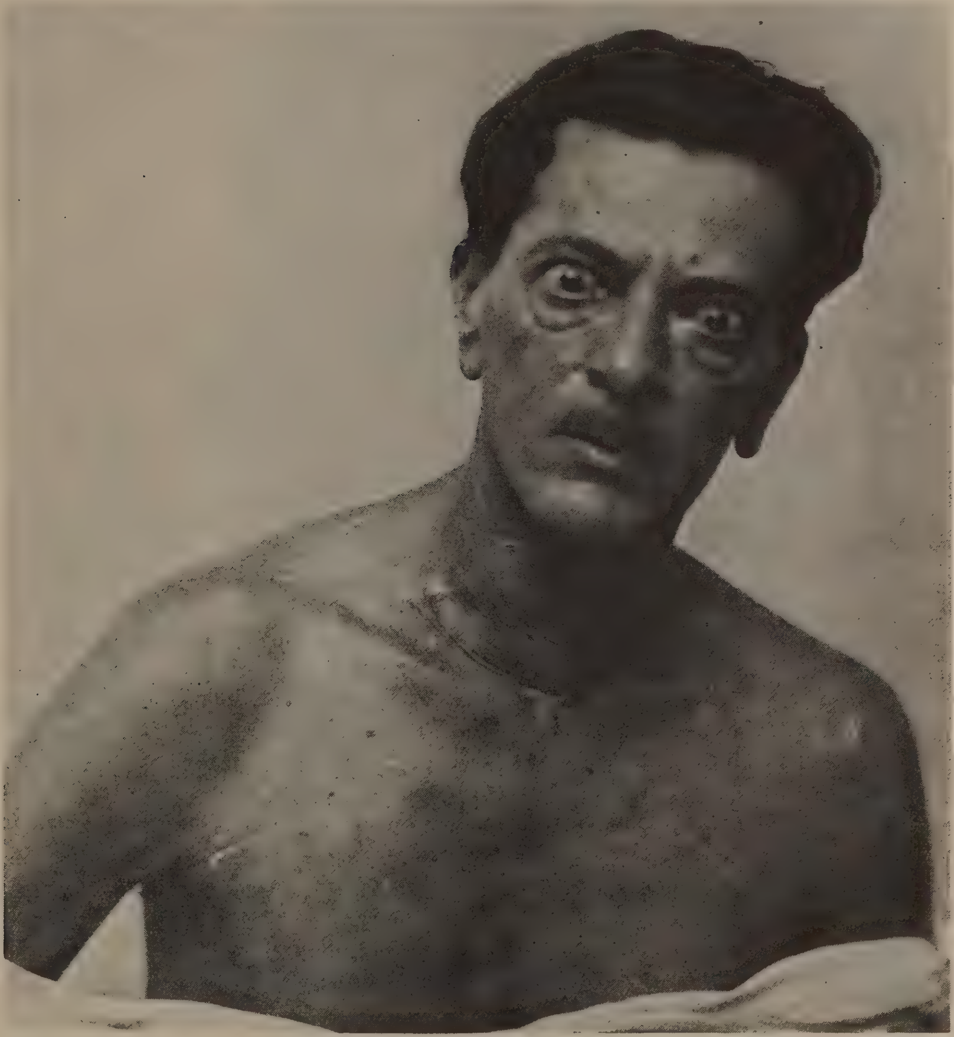

FIG. 1

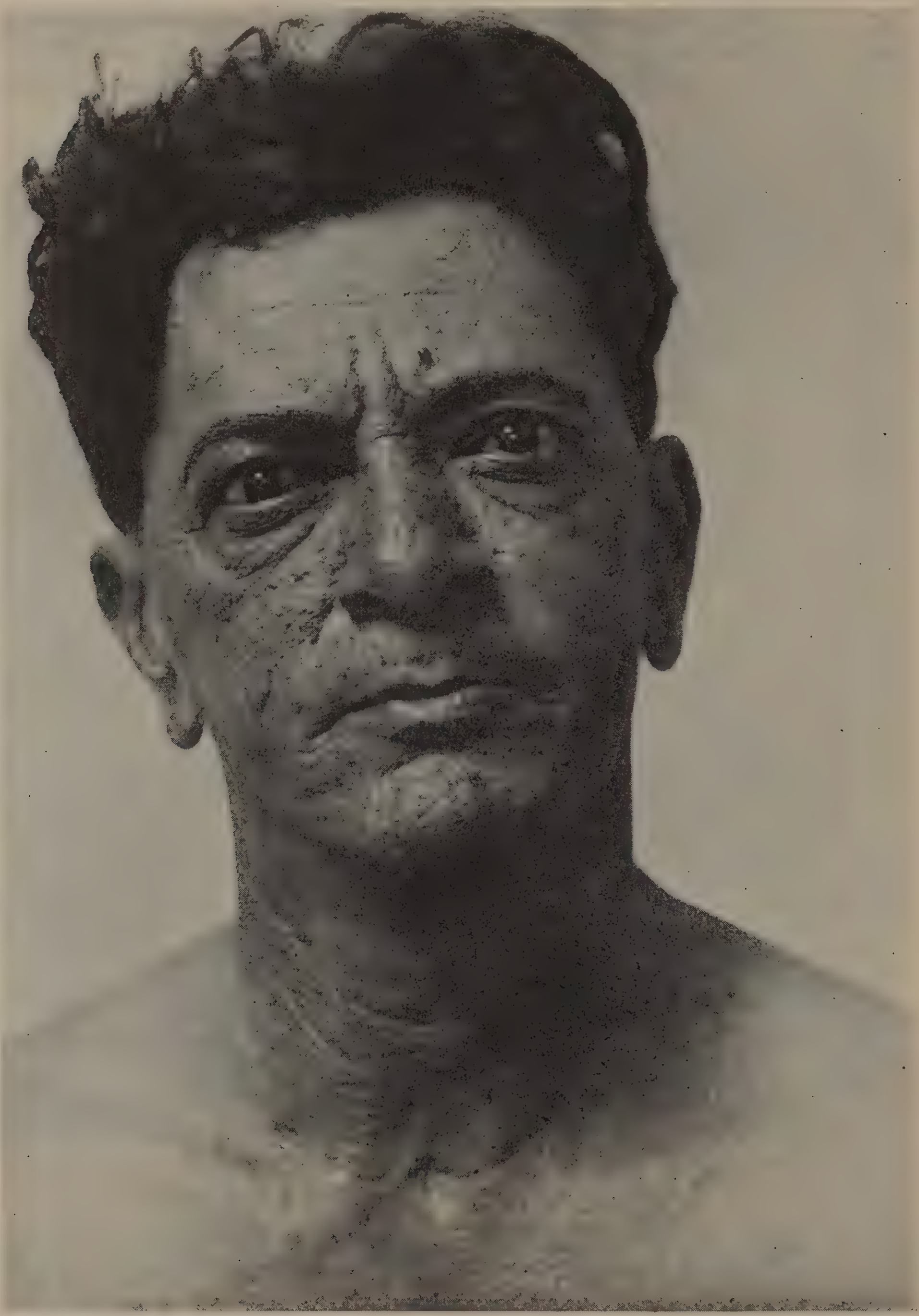

FIG. 2

Physical Examination.—The patient appeared somewhat emaciated and exhausted, and extremely nervous; and said that he had lost considerably in weight. He was very sick, and unable to walk; moved in bed with an effort; and complained of cardiac palpitation, anorexia, insomnia, and constipation. The eyeballs protruded and had a staring, anxious expression; and there was some conjunctival irritation, attributed to exophthalmus. Von Graefe's sign was well developed and persistent; and Moebius's sign was +++. Tremor of extremities was marked, with exaggeration of the deep reflexes. The pulse was rapid (120 pulsations to the minute), with associated systolic murmurs over the precordial area. The thyroid gland showed an irregular enlargement, with a predominance of the right lobe. Presence of slight bruit was elicited; but no thrill detected. Blood pressure was 190/100. The teeth were in poor condition.

Laboratory Report.—Albumin, casts, pus, and a slight amount of blood were present in the urine. His blood examination was negative for malaria; haemoglobin, 75%; Wassermann and Kahn reaction, negative. Basal metabolism was not taken.

Diagnosis and Treatment.—A diagnosis of toxic goitre was made; and the patient was given Lugol's solution and sedatives, and put to bed on rest treatment. As his general condition improved, he was permitted to take an occasional sea-bath. After four months of hospitalization and treatment, his condition remained at a standstill with a pulse rate varying between 80 and 104; and an operation was then decided upon. All urinary symptoms had subsided early in the course of his treatment. At operation, under ether anaesthesia, both lobes of the thyroid gland were found enlarged and quite hard. The entire left lobe and one-half of the right were removed, and the usual drainage inserted at the time of closure. One c.c. of adrenalin solution was administered hypodermically, during the operation, on account of a failing circulation. The administration of Lugol's solution was resumed after the operation; and recovery was uneventful. He was discharged on September 7th, 25 days after the operation, in good condition; but was advised to rest at home. His pulse rate at that time ranged between 80 and 90; and he had also gained in weight.

Comments.—The patient has been examined at irregular intervals since he was discharged from the Hospital; and, on each examination, appeared improved. He has never had to return to the Hospital for further treatment. His last visit for observation was in October, 1931—about 18 months after the operation. The pulse rate at that time was 82; his weight was 138–1/2 pounds—a gain of approximately 25 pounds; and his blood pressure was somewhat high—160/95. He stated that he was working daily, and felt perfectly well. He continues to take Lugol's solution in small doses, with intervals of rest. The pathological report on the thyroid gland tissue removed during the operation was as follows:

> "*Microscopic examination:* Thyroid. The glands are often irregular in shape and vary considerably in size. The smaller glands as a rule contain no colloid. In a

few places papillary projections are present. There is a marked infiltration of lymphocytes in the interglandular connective tissue which is increased in amount.

"*Microscopic diagnosis:* Follicular hyperplasia, (moderate degree), chronic inflammation."

(Signed) F. B. Mallory.

Illustrations.—Fig. 1 shows the patient's condition about 12 days after the operation—the persistently staring expression is quite noticeable. Fig. 2 shows the same patient about 18 months after operation for partial thyroidectomy—the recession of exophthalmus, calm expression, and gain in weight, is quite apparent. It is regretted that no photograph was taken at the time of admission.

POLYCYSTIC KIDNEYS—WITH CASE REPORT

B. M. Phelps, M.D.
Truxillo Railroad Company Hospital
Puerto Castilla, Honduras

Polycystic kidneys are usually bilateral. They are formed of a mass of cysts which contain colloid-like material, which may be one of various colors. The fluid may vary from the color of urine to dark brown, probably depending on the amount of hemorrhage.

On section, it may be impossible to distinguish, grossly, any renal tissue; and difficulty may be experienced in finding renal tissue microscopically, tho such kidneys seem to have sufficient normal tissue to sustain life for many years.

Cystic disease in other organs of the body, especially the liver, is often found.

The pathogenesis is not known, but the most feasible theory is that of congenital defects; in some cases being due to abnormal growth of wolffian bodies, whereas in others the disease seems to be of the nature of cystadenoma.

The clinical features may be very variable. Renal colic, hematuria, gastric disturbances and pressure symptoms send the patient to the physician; and a nodular tumor, generally bilateral, is discovered. The urine may be normal; but may increase in quantity, and contain albumin at intervals. Suppuration may occur. Cardiac hypertrophy and hypertension is the rule.

The treatment is palliative; tho nephrectomy has been performed, generally due to mistaken diagnosis. Nephrotomy and drainage has been performed, but operative interference is contraindicated except for the relief of sepsis, stones, and infection. Death is generally due to uremia.

CASE REPORT

G. Y. J., male, mestizo, age 35 years, married, was admitted to the hospital May 9, 1930.

History of Present Illness.—One year ago he began to notice a dull pain in the left upper abdomen. This later developed into a constant feeling of heaviness. About

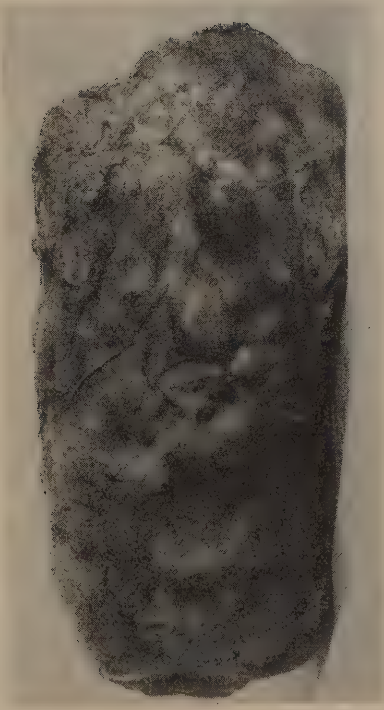

FIG. 1. LEFT KIDNEY

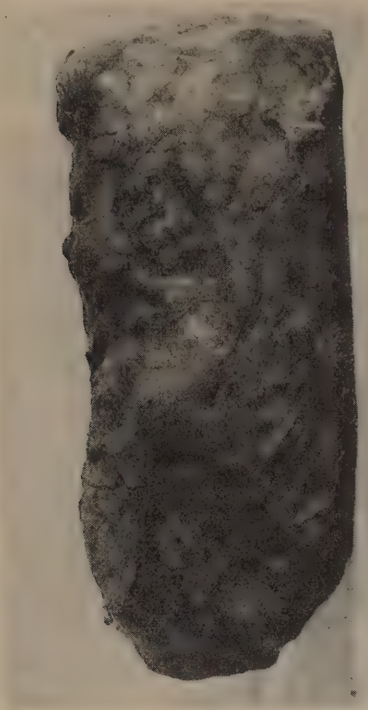

FIG. 2. RIGHT KIDNEY

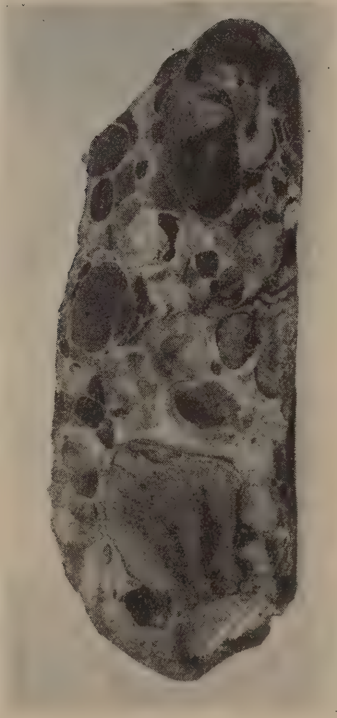

FIG. 3. LEFT KIDNEY SECTIONED

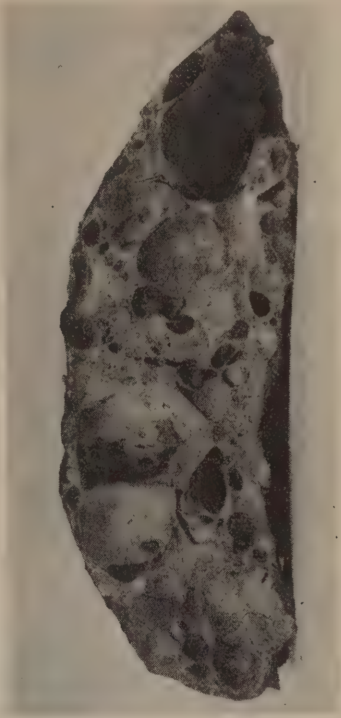

FIG. 4. RIGHT KIDNEY SECTIONED

nine months ago, he visited a physician who noticed a tumor. The patient has lost about 40 pounds weight during the past year. His appetite is poor. He used to vomit after eating; but now the vomiting is more bilious in character, and tends to occur in the morning without relation to the taking of food. The bowels are regular, and he has no complaint of urinary symptoms.

Physical Examination.—Moderately well nourished male but looked as though he had lost weight. There was a lemon tinted jaundice of the skin and sclerae. The tongue was heavily coated, and there were a few carious teeth. The heart and lungs were negative. A tumor in the left upper abdomen was noted visually and, on palpation, this proved to be large, nodular, and immovable but not very tender. Slightly to the right was a smaller tumor of similar character; but connection to the tumor on the left could not be verified. The position and size of the spleen could not be determined by palpation nor percussion. There was an old scar of a previous right inguinal hernia operation. The blood pressure was: systolic, 130; diastolic, 104. The urine had a specific gravity of 1.005; was acid in reaction; and contained a slight trace of albumin, some pus, blood cells and epithelium. The blood and stool examinations, and the Meinicke flocculation test, were negative. The red blood cells numbered 3,000,000; white cells, 12,800; lymphocytes, 21%; polymorphonuclears, 49%; and the hemoglobin was 80% by the Tallquist scale. Cystoscopy was impossible on account of a stricture of the urethra.

Course of the Disease.—On the patient's insistence, and with the hope that the tumor might be unilateral, an exploratory operation under spinal novocain was done on May 11th.

The peritoneum was smooth; and the liver and gall-bladder were normal in size, and smooth. Two massive fixed tumors sprang, retroperitoneally, respectively from right and left kidney regions, the right being somewhat smaller and inclining to the left side. Both tumors were studded with large nodules, cystic in character and almost black in color.

Convalescence progressed favorably until May 18th, when uremic symptoms intervened and the patient died May 20th.

*Necropsy** (*after embalming with formalin*).—Heart and lungs were normal. Two nodular, retroperitoneal polycystic tumors replaced the kidneys. The right tumor was 20.5 x 10.5 x 7.5 centimeters and weighed 1,750 grams. The left tumor was 22.5 x 11.5 x 8.5 centimeters and weighed 2,300 grams. The suprarenals were not found. Other abdominal organs were normal.

Microscopic Examination.†—Kidneys: a few of the glomerular tufts were hyaline and a few others sclerosed. The rest were practically negative. Most of the tubules were more or less dilated, and some formed cysts of various sizes. Many contained hyaline casts; and some of the cysts were filled with the same material. A few tubules contained polymorphonuclear leucocytes and fibroid masses. The stroma was considerably increased in amount and, in places, was infiltrated with lymphocytes. The liver was negative.

Microscopic Diagnosis.—(1) Congenital cystic kidneys; (2) slight acute tubular nephritis; (3) chronic nephritis.

Comments.—The case reported conforms to the classical description, with the exception of the lack of cardiac involvement, hypertension and scanty urinary findings. Operation on the rarer unilaterial cases carries a mortality rate of 30% or more.

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* **Dr. Walther Jantzen, Puerto Castilla, Honduras.**

† **Dr. F. B. Mallory, Boston City Hospital, Boston, Mass.**

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STRANGULATED DERMOID CYST COMPLICATING PREGNANCY

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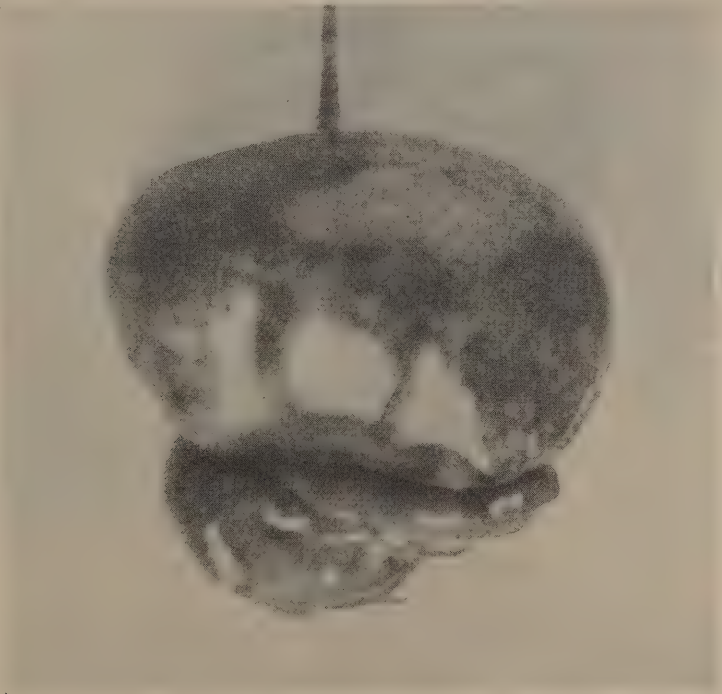
United Fruit Company Hospital
Santa Marta, Colombia

A female, married Colombian, aged 17 years, was admitted to the Hospital with a history of severe attacks of colicky pains, associated with vomiting, which had persisted for the preceding eight days. She stated that she was about six months pregnant and a primipara; and that she had received medical attention previously, with temporary relief only.



STRANGULATED DERMOID CYST

Shortly before admission, she had suffered a recurrence of the pain and vomiting. When she entered the Hospital, she was crying with intense pain; and it was necessary to administer a full dose of morphine in order to relieve her.

The physical examination at this time revealed a large, pregnant uterus, reaching to a level above the umbilicus; and a palpable, very tender, tumor mass on the left side of the abdomen about midway between the iliac crest and the costal margin. Owing to her advanced pregnancy, it was impossible to ascertain definitely the nature and attachments of the mass by bimanual examination. She had no fever, and the pulse rate was but slightly increased. Clinical laboratory reports showed the urine to be negative, the blood negative for malaria, and a slight increase in leucocytes.

An exploratory laparotomy was performed the following day, under spinal anaesthesia. Upon opening the abdomen through a left rectus incision, there was disclosed a large, somewhat movable, deeply cyanotic tumor the size of a large grapefruit. It consisted of the left ovary and tube; and both organs were engorged and oedematous as a result of torsion of the pedicle. The tube, especially, was enormously enlarged; and was greatly out of proportion to that of the opposite side. The entire mass was excised without much difficulty and with no loss of blood; and the abdomen was closed without drainage. Recovery was uneventful, in fifteen days. Gross section of the tumor revealed an abundant admixture of hair and sebaceous material. The tube showed fairly large haemorrhagic areas throughout; with other early necrotic changes in both organs.

Comments.—This case is of special interest; as it presents an unusually severe complication during an otherwise normally advanced pregnancy, and as no interruption of the pregnancy occurred despite the acuteness and severity of the symptoms and the operative interference. Gangrene and peritonitis would unquestionably have developed in a very short time, with fatal results in all probability, had she not submitted to the operation. The accompanying illustration shows the tumor, which was considerably larger in its original state and weighed about five pounds.

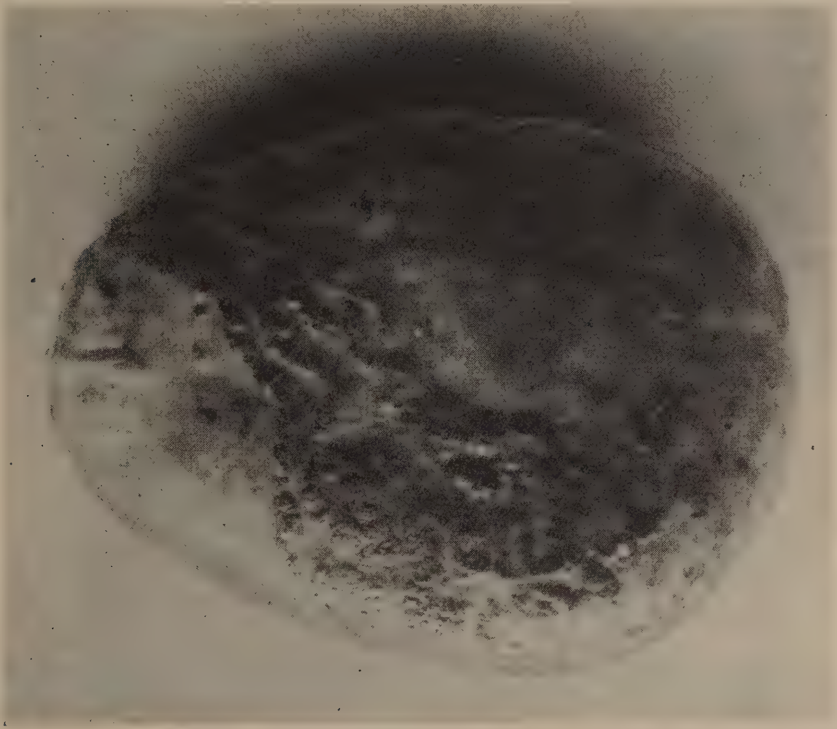
A LITHOPEDION

L. M. Drennan, M.D.
United Fruit Company Hospital
Santa Marta, Colombia

A female Colombian, 16 years of age and married, was admitted to the Hospital on January 29th, 1932. She gave a history of having had severe and acute pain in the left lower abdomen about eight months previously; and stated that the pain had continued to recur, in a lesser degree, at irregular intervals. Menstrual periods had been normal recently; but there had been irregularity and excessive flowing about nine or ten months earlier. At the time of admission, she complained of leucorrhea.

Vaginal inspection showed a moderately inflamed cervix; and, on bimanual examination, the uterus was found retroverted. The vaginal vaults were tender, especially in the region of the pouch of Douglas. Microscopic examinations of smears from the cervix were reported positive for pus, but negative for gonococci and trichomonas vaginalis. The urine contained pus, and a heavy trace of albumin; and the blood was positive for tertian malaria. The pulse and temperature were normal.

An operation was performed on the day following the patient's admission; and the lower mid-line incision was selected. The exploring hand, which was inserted to the bottom of the pelvis to elevate the displaced uterus, encountered a free-floating body of flat, stony consistency. The body was about the size of a silver dollar, had a smooth surface, and was approximately ½-inch thick. Further inspection revealed the absence of the left ovary and about two-thirds of its fallopian tube, and the distal end of the latter was smoothed off. The pelvic cavity was otherwise clean and free from adhesions. The left ovary contained a moderate-sized follicular cyst; the tube was normal; and the uterus was about normal size and in retro-position.



LITHOPEDION

At first sight, this unusually curious specimen very much resembled a foreign body; but further examination revealed that it was the atrophic remnants of the left ovary and tube. It appears that the pedicle had become strangulated from some pathological condition which was present when her first symptoms became manifest, and that the process continued unabated until detachment occurred. This would evidently explain the cessation of all acute symptoms at that time. The accompanying illustration shows the gross appearance of the specimen at the time of removal.

The pathological report received from Dr. Herbert C. Clark, Director of the Gorgas Memorial Laboratory, was as follows:

> "We received a pathological specimen on February 16, 1932 from C. Y., age 16 and case number 159 for the year 1932. An abstract of the case history also accompanied the specimen.
>
> "*Report on Pathological Specimen U. F. Co. 58:* The gross specimen was a half inch wide and one inch long and about a quarter of an inch in thickness. It was cut into slices about a quarter of an inch thick, but all slices were held on one side by the uncut capsule. It was too dry and hard to cut with our microtome knives; but, by the use of a safety razor blade, we secured three sections through the middle of the hard mass.
>
> "*Microscopic examination:* A dense fibrous capsule surrounded the specimen; and most of the space within the capsule was taken up, apparently by an old clot in a degenerated state. The rest of the mass is of mixed tissue so degenerated that identification of the structures is impossible. It suggests, however, the degenerated remains of an ectopic pregnancy.
>
> "The history of the case, with the findings just mentioned, certainly suggest ectopic pregnancy with tubal abortion, death of the fetus, absorption of the fluids, mummification and impregnation with lime salts of the ectopic products—a lithopedion."

MYOMA OF THE BROAD LIGAMENT

L. M. Drennan, M.D.
United Fruit Company Hospital
Santa Marta, Colombia

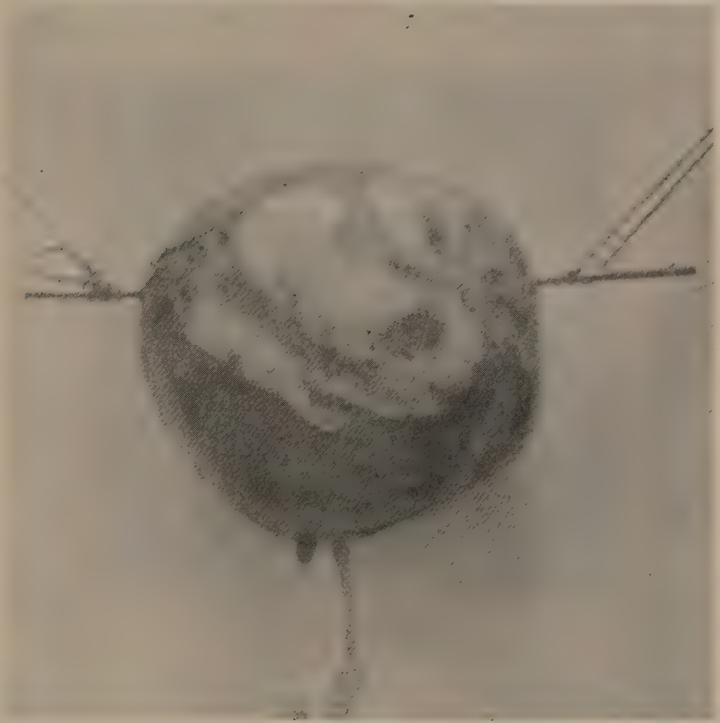
A Colombian housewife, who was 42 years of age and a multipara, was admitted with a history of four days of intense pain in the right lower abdomen accompanied by nausea but no vomiting. She had a slight fever.

The general physical examination revealed nothing of importance; but, on vaginal examination, a large, firm, tender mass was found in the right upper and outer quadrant of the pelvis. This mass was very tender on palpation of the abdomen. The clinical laboratory report was as follows: urine, negative; blood, negative for malaria parasites; haemoglobin, 75%; white cell count, within normal limits; polynuclear neutrophiles, 54%.

Operation was performed the following day, under spinal anaesthesia; and a large, hard tumor, the size of a small melon, was found embedded in the right, broad ligament. During its growth, this tumor had encroached considerably on the pelvic cavity; and had crowded the uterus, tubes, and ovaries against its left lower and outer wall. These organisms were otherwise normal in appearance.

With some difficulty, the tumor was enucleated from within the confines of the broad ligament; and, to prevent oozing caused by extensive dissection, the layers of the broad ligament were united by mattress sutures. The patient made an uneventful recovery, in two weeks time.

Comment.—On section, the gross appearance of the tumor was that of a typical, hard, solid, myomatous tumor; as is shown in the accompanying illustration. The tumor weighed 4 pounds. Primary tumors of the round and broad ligaments are considered quite rare; and this is the first one of its kind encountered here.



MYOMA OF THE BROAD LIGAMENT

A PECULIAR FINDING IN THE CEREBRAL FLUID OF A MAN WHO DIED FROM NON-EPIDEMIC MENINGITIS

WALTHER JANTZEN, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

The microphotograph (Fig. 1) herewith shows a smear taken from the ventricular fluid of the brain of a man who died from non-epidemic meningitis. The picture shows well the worm-like formation amidst a large amount of pus cells, and gives all the details of the original smear. Though I do not believe that the pathological finding reported herein caused any clinical symptoms, I will give a short history of the case:

W. D., 27 years of age, male, from the island of Bonacca, entered the hospital on December 8th, 1930. He complained of stiffness of the neck and some headache, which he had had for several weeks, and which had gotten much worse during the last few days.

On entrance, there was a slight but distinct stiffness of the neck. The Meinicke test was positive; and the blood smear for malaria showed a few E. A. rings. The temperature was 102 degrees F. He was treated with quinine injections, potassium iodide and neo-salvarsan. Sudden death occurred three days later, with symptoms of paralysis of respiration.

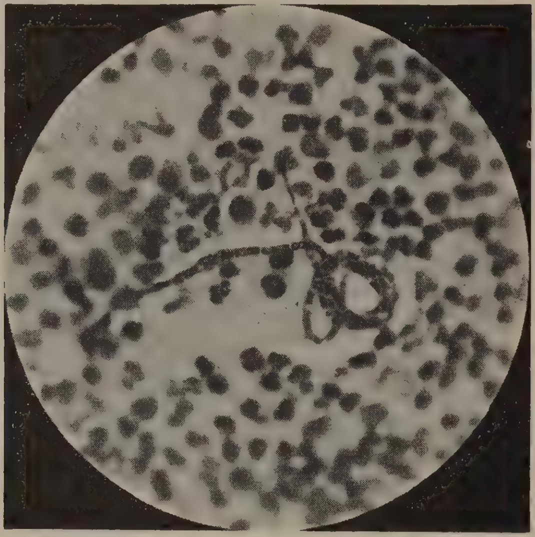


FIG. 1

The autopsy of the head, performed three hours after death, showed edema of the brain and a slight turbidity of the cerebral fluid. A few white flakes were floating in the fluid of the ventricles. From these flakes, smears were taken which showed many pus cells, a few diplococci and, in one smear, the formation mentioned above.

As I was unable to identify the specimen, I sent the smear to Prof. Fülleborn, Hamburg, asking for his opinion. He believes it to be a "pseudoparasite." He had found, as he wrote me, similar but shorter formations in blood smears several times in the course of the years, without having been able to make a positive diagnosis.

POST-MORTEM SUMMARY

Walther Jantzen, M.D.
Truxillo Railroad Company Hospital
Puerto Castilla, Honduras

Eighty adults and 15 children died in the hospital during the year 1931. Complete or partial postmortem examinations were made on the bodies of 45 of these cases. No extraordinary nor striking features were noted in these examinations.

The average age of the adults who died was 31 years; the oldest being 60 years, and the youngest 16 years.

Malaria, as a cause of death, was not noted among this year's cases; but traces of chronic malaria, such as malaria pigment in bone marrow and spleen and the presence of chronic splenitis, were found in a large percentage of cases. Undoubtedly, this chronic infection played a prominent rôle in the lowering of body resistance to other diseases.

Eight patients died of hemoglobinuric fever during the year. One of these cases was autopsied, and the clinical diagnosis was confirmed.

Tuberculosis of the lungs and adnexa, as a cause of death, was found in three instances. One patient died from a tuberculous pleurisy and pericarditis. Another patient showed a miliary tuberculosis, originating from a tuberculous area the size of a walnut, located in the upper lobe of the right lung. A boy, aged 7 years, had a tuberculosis of the glands of the hilum, with a complication of malaria and severe anemia. One case of Pott's disease was noted: the process had involved the bodies of the 5th, 6th, 7th and 8th thoracic vertebrae, with compression and degeneration of the corresponding area of the spinal cord.

Anemia, of the pernicious type, was the cause of death of a pregnant woman.

A native man, who was admitted to the hospital in an unconscious condition and died shortly afterwards, was grossly and microscopically diagnosed typhoid fever—probably in the third week of the disease. Another case, with a vague and indefinite history of severe pain in the abdomen followed by unconsciousness and death, was found to have a severe gastroenteritis complicated by E. A. malaria.

Three patients died of septicemia. The origin in one case was from an infected uterus, following childbirth outside of the hospital. The second case developed in a baby, ten months of age, following a severe attack of impetigo. The third case had the striking feature of deep multiple muscle abscesses (myositis purulenta tropicalis).

Multiple abscesses in the right cerebral hemisphere were found in one case. It was impossible to trace the path of infection in this case, though the condition is known to be practically always secondary in character.

Meningitis was recorded four times as a cause of death. Meningococci were found in two cases, and pneumococci in the other two cases.

Infections of the respiratory system were frequently seen, bronchopneumonia often occurring as a secondary condition. Eight patients, dying from lobar pneumonia, were autopsied. A single lobe only was involved in one case who had just recovered from an attack of amebic dysentery. Two, three and four lobes were involved in the inflammatory process in, respectively, four, two and one cases. Complications noted were as follows, in one case each: glomerulonephritis, hydronephrosis, small empyema, a large lung abscess, chronic pneumonia, exudative pericarditis with dilatation of the heart and a beginning cirrhosis of the liver. The clinical features of this latter case were especially interesting, as the man had undergone a splenectomy some years ago; and exact data in this case are taken up in a special paper.

One patient, 32 years of age, showed a gliosarcoma replacing the left basal ganglia of the brain. The symptoms caused by this tumor were those usually presented in epidemic encephalitis, especially apathy and somnolence. He was aroused with difficulty, to answer questions or to take nourishment.

A rupture of a middle cerebral artery, with hemorrhages and thrombosis, was seen in one case. There was extensive hemorrhage into and beneath the pia mater, corresponding to the right middle cranial fossa, with compression of the temporal lobe. The basic pathology was probably chronic nephritis.

A man, 40 years of age, died with a hemiplegia. This was caused by an area of softening, about 8 cm. in extent, located within the internal capsule of the left hemisphere. This was probably secondary to an infection of the large intestine.

Pathological conditions affecting the circulatory system were noted, and were considered the primary cause of death, in 6 cases. One case presented a purulent pericarditis, with dilatation of the heart; mycotic endocarditis of the tricuspid valve was seen in one case, and the same disease of the bicuspid valve in another case; a child died of an acute dilatation of the heart, after having been convalescent from tetanus for 2 weeks. A woman, about 60 years of age, showed a degeneration of the myocardium complicated by atheroma and chronic nephritis. Another case, 38 years of age, with a history of excessive use of tobacco over a long period of time, showed a dilatation of the heart with pronounced sclerosis of the coronary arteries and aorta.

Cirrhosis of the liver, of the Laennec type, was seen in a patient who was 37 years of age. An exceptionally large spleen (1,250 grams) was present, suggesting that the pathological changes might be due to chronic malaria.

Ascending suppurative nephritis, complicated by prostatic hypertrophy, was the cause of death in one case. In another case, a malignant nephrosclerosis decided the issue.

During the year, there were many deaths from external causes such as gunshot and machete wounds. As a rule, these cases do not come to autopsy unless death has occurred a considerable time after the injury. Of those autopsied, 3 cases had severe lesions of the abdomen or chest caused by gunshot wounds; in 2 cases, wounds inflicted by machetes showed fractures of the skull, with infection of the brain and meninges; and 1 case died of internal hemorrhage caused by a rupture of the spleen, as a result of a crushing in a train accident.

BOOK REVIEW

BRIEF REVIEW OF: "APPROVED LABORATORY TECHNIC." PREPARED UNDER THE AUSPICES OF THE AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS BY JOHN A. KOLMER, M.D., DR. P. H., D.SC., LL.D., AND FRED BOERNER, V.M.D., ASSISTED BY C. ZENT GARBER, A.B., M.D.

The preface of this work by the senior authors gives, in trenchant language, the aims of the writers and their collaborators. The scope, as outlined on the title page, includes Clinical Pathology, Bacteriology, Serology, Biochemistry and Histology. The sponsorship of The American Society of Clinical Pathologists places it in the front rank of works on laboratory procedure and diagnostic methods. The table of contents indicates a wide range of methods and comprehensive tests in the various diagnostic domains. The forty pages of index are most useful. The volume, which was published in 1931 by D. Appleton and Company, consists of 663 pages, with eleven colored plates and 300 illustrations in the text.

The reviewer was impressed, first, with the wealth of good illustrations. In the operations of a laboratory in the tropics, a large amount of instruction must be given to native helpers. It is the experience of the writer that a first-class illustration of a group of microorganisms, of urinary sediments, or of helminth eggs, etc., with a demonstration of the same specimen under the microscope, will tend to fix it in the memory of the technician much better than a simple demonstration by the microscope alone. In this book, the colored plates in general are not nearly as exact in color value as could be desired; and Plate IV is unfortunate in the depiction of the malaria parasites. Also, malaria pigment, as seen in phagocytic cells, has a rich seal brown to black color. It is hoped that subsequent editions will have a better color representation of the various stages of schizogony of the malaria parasites, and of the gametocytes as observed in Romanowsky stains of the peripheral blood. If the book creates a sufficiently wide demand in the tropics and in parts of the temperature zones where the diagnosis of malaria is routine, a colored plate of the malaria parasites as seen in well-stained thick films would be indicated. Very few laboratory manuals or text books have such a plate; and those that the reviewer has seen show numerous parasites. For value in teaching, the microscopic appearance in the scanty infections—only a few parasites, at the most—should be shown in the field.

In the six hundred and twenty-two pages of text and illustrations, concise directions are given for the obtaining of specimens, the proper performance of the various tests and procedures, and for the interpretation of the results. Not all of the tests and procedures described in this text will be used by workers throughout the world. In laboratory practice, as in most of the domains of medicine, there are several roads that lead to Rome; and the experienced worker will depend upon the method that he is familiar with, and the method which, in his hands, leads to a clear-cut diagnosis. This, however, does not belittle in the slightest the methods set forth in this manual; and probably the beginner would more quickly and surely master the art of laboratory diagnosis by its use.

Chapter III should be read with sympathy and understanding of our clinical brethren. Critical judgment on the part of the practitioner in sending requests for pertinent and worthwhile laboratory examinations is a rare virtue. This acumen is generally in direct proportion to his ability as a clinician and to the care with which a patient has been studied from the standpoint of anamnesis and physical examination before an extensive and expensive amount of laboratory examinations is ordered. Too frequently the clinical laboratory is overburdened with useless or vanity-salving requests. The force of the clinical laboratory, under such conditions, are like squirrels in the wheel-cage—they do a lot of work without results which are of positive or negative value. Yet, on the other hand, in dealing with ignorant and illiterate patients, certain selected tests are justified as a matter of routine, and a greater number of diagnoses of clinical conditions will be arrived at than if large amounts of time be expended in taking long but unreliable histories.

Chapter XXXVI shows the discriminating judgment of the authors and Editorial Staff to include the most recent methods of value in laboratory diagnosis. This short chapter gives, in a little over two pages, the technic and interpretation of the "Aschheim-Zondek" and "Friedman" tests for early pregnancy.

Books for use in the tropics should have a strong binding with leather or fabrikoid. Despite care, the cockroaches are ubiquitous and are very partial to the sizing in the ordinary clothbound book. If the books are not treated with shellac or are left out of a case, these insects will deface the binding in no time. The extra cost of a leather-bound volume would probably not be considered, in comparison with the added appearance and durability. It is suggested that a proportion of each subsequent edition be bound in leather for tropical use.

In conclusion, the reviewer wishes to congratulate the authors and Editorial Staff on the production of this volume, as it offers to all laboratory workers an additional and up-to-date manual on Laboratory Technic.

LAWRENCE GETZ, B.A., M.D., F.A.C.P.
Chief of Laboratory
The Herrick Clinic and Hospital de Panama

Panama, R. P.

SECTION V

ORGANIZATION AND VITAL STATISTICS

SCOPE OF MEDICAL DEPARTMENT

Phases of the Work.—The Medical Department functions with respect to all conditions pertaining to the prevention of disease and the care of the sick and injured. This work embraces the following phases:

(a) In the Tropics, care of employees and their dependents; and of the habitants of communities within the limits of, or contiguous to, the plantations when no other medical service is available.

(b) On all the Company's steamships, care of passengers and members of the crews. Free radio-medical service is given to the Captains or Doctors aboard the steamers of any line, whenever professional advice is sought by radio.

(c) In the Domestic Divisions where the Company maintains medical staffs, dispensary service to employees.

(d) Physical examination of prospective salaried employees, and of steamship crews before they leave the home port at the beginning of each voyage.

(e) Supervision of all quarantine and immigration matters which affect the Company's interests.

(f) In the Tropical Divisions, supervision of all matters pertaining to sanitation.

(g) Sanitation of the Company's steamships.

For the effective performance of these many and varied duties, the Company maintains fully equipped hospitals and dispensaries in the Tropical Divisions, and dispensary service with sanitary staffs in the ports of New York, Boston and New Orleans.

PERSONNEL OF THE MEDICAL DEPARTMENT

Name	Title	Graduate of
R. C. Connor, M.D.	General Manager, New York, N. Y.	University of Texas School of Medicine, Galveston, Texas
J. S. Cudlipp	Assistant to General Manager, New York, N. Y.	
A. Castellani, M.D., C.M.G., F.R.C.P.	Consultant in Tropical Dermatology, London	Royal University of Florence Faculty of Medicine and Surgery, Italy University of Bonn Faculty of Medicine, Germany
H. C. Clark, M.D.	Consultant in Preventive Medicine, Tropical Pathology, and Laboratory Work, Panama, R. de P.	University of Pennsylvania School of Medicine, Philadelphia, Pa.
W. M. James, M.D.	Consultant in Tropical Medicine, Panama, R. de P.	University of Virginia Department of Medicine, Charlottesville, Va.
R. P. Strong, M.D.	Consultant in Laboratory and Medical Research Work, Boston, Mass.	Johns Hopkins University, Baltimore, Md.

Name	Title	Graduate of
P. F. Murphy, M.D.	Port Medical Officer, New Orleans, La.	Tulane University of Louisiana School of Medicine, New Orleans, La.
L. R. Shearin, M.D.	Assistant to Port Medical Officer, New Orleans, La.	University of Tennessee College of Medicine, Memphis, Tenn.
J. M. Lawler, M.D.	Port Medical Officer, New York, N. Y.	Vanderbilt University School of Medicine, Nashville, Tenn.
J. A. Gatlin, M.D.	Sanitary Inspector, New York, N. Y.	Memphis Hospital Medical College, Memphis, Tenn.
F. X. Crawford, M.D.	Port Medical Officer, Boston, Mass.	Harvard University Medical School, Boston, Mass.
Carleton Hale	General Sanitary Inspector, New York, N. Y.	

CHIRIQUI LAND COMPANY

Name	Title	Graduate of
Manuel D. Rojas, M.D., Ph.C.	Superintendent	Tulane University of Louisiana School of Medicine, New Orleans, La. University of Michigan, Ann Arbor, Mich.
Rafael DeBoyrie, M.D., C.M.	Physician and Assistant to Superintendent	McGill University Faculty of Medicine, Montreal, Quebec, Canada
Helen Flanagan, R.N.	Matron	Massachusetts General Hospital School of Nursing, Boston, Mass.
Tillie de Soto, R.N.	Nurse	John Sealy Hospital School of Nursing, Galveston, Texas
Liboria M. Rivera, R.N.	Nurse	Santo Tomas Hospital School of Nursing, Panama, R. of P.
Tulio von Bulow, B.S.	Laboratory Technician	Geneva University, Geneva, Switzerland
Guillermo Aldana	Pharmacist and Hospital Dispenser	Instituto Nacional, Panama, R. of P.

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—32

COLOMBIA DIVISION

Name	Title	Graduate of
L. M. Drennan, M.D.	Superintendent	Georgetown University School of Medicine, Washington, D. C.
E. Thonnard-Neumann, M.D.	Physician and Assistant to Superintendent	University of Frankfurt-am-Main, Faculty of Medicine, Frankfurt, Germany
J. Camacho, M.D.	Physician	Universidad de Valencia Facultad de Medicina, Spain
M. E. Duran, M.D.	Physician	Northwestern University Medical School, Chicago, Ill.
Octavio M. Tatis, M.D.	District Medical Officer	Universidad de Bolivar, Cartagena, Colombia
Francisco Valera, M.D.	District Medical Officer	Universidad de Valencia Facultad de Medicina, Spain
Andre H. LeDoux	Laboratory Technician	
Martha W. Vessels, R.N.	Matron	Capital City School of Nursing, Washington, D. C.
Agnes K. Donegan, R.N.	Assistant to Matron	Victoria Hospital, Yorkshire, England
Esther C. Severson, R.N.	Nurse	Hurley Memorial Hospital, Flint, Mich.
Mabel M. Willis, R.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—81

CORTES DEVELOPMENT COMPANY

Name	Title	Graduate of
Fred Cecil Watson, M.D.	Superintendent	Vanderbilt University School of Medicine, Nashville, Tenn.
Angel Augusto Ulloa, M.D.	Assistant Physician	Jefferson Medical College of Philadelphia, Philadelphia, Pa.

Name	Title	Graduate of
Rafael A. Martinez, M.D.	Physician in Charge, La Lima Hospital	St. Louis University Medical School, St. Louis, Mo.
Manuel Caceras Vijil, M.D.	Assistant Physician, La Lima Hospital	Universidad de Honduras, Facultad de Medicina, Tegucigalpa, Honduras
Kenneth C. Brewster, B.S.	Bacteriologist	New Mexico College of Agriculture and Mech., N. M.
Catharin Cotter, R.N.	Matron	Kings County Hospital School of Nursing, Brooklyn, N. Y.

Total Number of Employees, Other Than Doctors, Registered Nurses, and Laboratory Technicians—27

Compañia Bananera De Costa Rica

Name	Title	Graduate of
E. I. Salisbury, M.D., F.A.C.S.	Superintendent	Jefferson Medical College, Philadelphia, Pa.
A. A. Facio, M.D., F.A.C.S.	District Medical Officer, San José	University of Pennsylvania School of Medicine (Medico-Chirurgical College), Philadelphia, Pa.
Juan M. Jimenez, M.D.	Physician	Jefferson Medical College, Philadelphia, Pa.
Alberto Oreamuno, M.D.	Physician	Jefferson Medical College, Philadelphia, Pa.
Jose Miguel Jimenez, M.D.	Physician	Jefferson Medical College, Philadelphia, Pa.
A. Lachner Chacon, M.D.	District Medical Officer, Turrialba	University of Munich Faculty of Medicine, Munich, Germany
Maximo Gamboa, M.D.	Physician	St. Bartholomew's Hospital Medical College, London, England
Mary C. Walsh, R.N.	Matron	St. Joseph's Hospital School of Nursing, St. Paul, Minn.
Melva G. John, A.B., R.N.	Nurse	Denver University, Denver, Colorado; St. Mary's Hospital School of Nursing, Rochester, Minn.
Nona Corbett, R.N.	Nurse	St. Mary's Hospital, Brooklyn, N.Y.
Nathalie S. Kingman, R.N.	Nurse	Chelsea Memorial Hospital, Chelsea, Mass.; Manhattan Eye, Ear and Throat Hospital, New York, N. Y.
Thea Hoffman, R.N.	Nurse	Koblenberg Stift Maydeburg, Germany
Kathryn McGrath, R.N.	Nurse	Georgetown University Hospital School of Nursing, Washington, D. C.
Josephine W. Shrine, R.N.	Nurse	Public General Hospital, Kingston, Jamaica

Total Number of Employees, Other Than Doctors, Registered Nurses, and Laboratory Technicians—79

Cuban Divisions

Name	Title	Graduate of
Jaime de la Guardia, M.D.	Superintendent, Cuban Divisions	Jefferson Medical College, Philadelphia, Pa.
P. S. Malaret, M.D.	Assistant Superintendent, Cuban Divisions	Medico-Chirurgical College, Philadelphia, Pa.
A. F. Ruiz, M.D.	Assistant Surgeon, Banes	Havana University, Havana, Cuba
Octavio Ortiz, M.D.	Assistant Surgeon, Preston	Havana University, Havana, Cuba
Cecelio A. Lecusay, M.D.	Physician, Preston	Havana University, Havana, Cuba
T. de la Torre, M.D.	District Medical Officer, Guaro	University of Maryland, Baltimore, Maryland
Vicente Bustillo, M.D.	District Medical Officer, Deleite	Loyola University School of Medicine, Chicago, Ill.
Wilhelm Cordes, M.D.	Bacteriologist and Roentgenologist, Preston	Marburg University, Germany
Matilda Baiz, R.N.	Matron, Preston	N. Y. Post Graduate Medical School and Hospital, New York, N. Y.
Lilian Dixon, R.N.	Matron, Banes	Hamilton General Hospital, Hamilton, Ontario, Canada
Ann de la Vergne, R.N.	Nurse, Preston	Oneida Private Hospital, Oneida, N. Y.

Name	Title	Graduate of
Micaela Perez, R.N.	Nurse, Preston	Robert B. Green Memorial Hospital, San Antonio, Texas
Catherine Clarke, R.N.	Nurse, Preston	Public General Hospital, Kingston, Jamaica
Lena Biggs, R.N.	Nurse, Preston	Public General Hospital, Kingston, Jamaica
Juan G. Marin, R.N.	Nurse (Male), Preston	Public General Hospital, Kingston, Jamaica
Francisca Archer, R.N.	Nurse, Banes	Public General Hospital, Kingston, Jamaica
Sibyl E. Chaplin, R.N.	Nurse, Banes	Public General Hospital, Kingston, Jamaica
Ivy L. Feres, R.N.	Nurse, Banes	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS, 85—(PRESTON, 46; BANES, 39)

GUATEMALA DIVISION

Name	Title	Graduate of
Neil P. Macphail, M.D.	Superintendent	University of Aberdeen Faculty of Medicine, Scotland
Ricardo Aguilar, M.D., D.D.S., F.A.C.P., F.A.C.S.	Surgeon	Universidad Central, Facultad de Medicina y Cirugia, Tegucigalpa, Honduras Strycher Dental School, New York, N. Y.
J. M. de los Reyes, M.D.	Physician	Jefferson Medical College of Philadelphia, Philadelphia, Pa.
L. R. Matthews	Laboratory Technician	
Myra Ellerby, R.N.	Matron	Middlesex Hospital, London, England
Margaret A. Storrow, R.N.	Nurse	Cumberland Infirmary, Carlisle, England
Ethel Currant, R.N.	Nurse	Royal Waterloo and Seamen Hospital, London, England
Maria Sagastume, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Santos Brizuela, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Isabel Figueroa, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Susana Campos, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—82

JAMAICA DIVISION

Name	Title	Graduate of
I. W. McLean, M.D., F.A.C.S.	Superintendent	University of Maryland, Baltimore, Md.
F. R. Evans, M.D.	District Physician, St. Thomas	Bellevue Hospital Medical College, New York, N. Y.

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—16

PANAMA DIVISION

Name	Title	Graduate of
O. T. Brosius, M.D., D.T.M. and H., F.A.C.P.	Superintendent	Tufts College Medical School, Boston, Mass.
Mae A. Kenney, R.N.	Matron	Worcester City Hospital School of Nursing, Worcester, Mass.

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—22

TELA RAILROAD COMPANY

Name	Title	Graduate of
R. B. Nutter, M.D.	Superintendent	Tufts College Medical School, Boston, Mass.
E. J. Whitaker, M.D.	Physician	State University of Iowa, College of Medicine, Iowa City, Iowa
A. E. Moure, M.D.	Physician	Sorbonne Medical School, Paris, France
J. C. McDaniel	Bacteriologist	
Betty Tomeny, R.N.	Matron	Charity Hospital School of Nursing, New Orleans, La.
Hildegard Hartman, R.N.	Nurse	Schassburg Hospital, Siebengurgen, Germany
Lila Maud Peart, G.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—55

TRUXILLO RAILROAD COMPANY

Name	Title	Graduate of
B. M. Phelps, M.D.	Superintendent	Vanderbilt University School of Medicine, Nashville, Tenn.
Walther Jantzen, M.D.	Physician and Bacteriologist	University of Kiel Faculty of Medicine. Germany
L. R. Fletcher, M.D.	Physician	Rush Medical College (University of Chicago), Chicago, Ill.
Jose A. Lopez, M.D.	Physician	George Washington University Medical College, Washington, D. C.
G. H. Robertson, R. N.	Matron	Sarah Leigh Hospital School of Nursing, Norfolk, Va.
Lillie B. McNeill, R.N.	Nurse	Wise Sanitarium, Plains, Ga.
America Ferrera, G.N.	Nurse	D'Antoni Hospital, La Ceiba, Honduras

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—70

SUMMARY OF WORK DONE AND VITAL STATISTICS

	Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
PERSONS DEPENDENT UPON THE MEDICAL DEPARTMENT FOR TREATMENT:																							
Employees:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
From Temperate Zone	105	10	117	10	150	6	135	15	509	28	162	12	80	2	52	4	227	9	177	7	1,714	103	1,817
Others	1,970	73	5,429	228	4,180	106	4,604	278	10,818	213	3,372	115	10,619	1,518	1,971	187	4,394	103	4,281	132	51,638	2,953	54,591
Non-employees:																							
From Temperate Zone	8	30	88	56	29	72	56	90	618	466	293	221	39	59	14	40	23	90	24	54	1,192	1,178	2,370
Others	586	947	2,818	2,672	1,319	2,727	2,393	3,752	10,391	13,751	6,606	5,316	5,309	7,964	1,300	1,616	811	1,354	832	1,806	32,365	41,905	74,270
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	115	2,043	127	5,657	156	4,286	150	4,882	537	11,031	174	3,487	82	12,137	56	2,158	236	4,497	184	4,413	1,817	54,591	56,408
Non-employees	38	1,533	144	5,490	101	4,046	146	6,145	1,084	24,142	514	11,922	98	13,273	54	2,916	113	2,165	78	2,638	2,370	74,270	76,640
TOTAL	153	3,576	271	11,147	257	8,332	296	11,027	1,621	35,173	688	15,409	180	25,410	110	5,074	349	6,662	262	7,051	4,187	128,861	133,048
Passengers on steamships	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	38,073
Officers, crews and ships' laborers	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	27,480
TOTAL	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	65,553
GRAND TOTAL	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	198,601
PATIENTS TREATED IN HOSPITALS:																							
Employees:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
From Temperate Zone	73	4	90	2	62	1	55	2	148	5	95	7	16	......	19	......	75	2	130	4	763	27	790
Others	685	19	1,890*	60	2,322	14	1,689	104	1,639	24	1,207	52	16	3	452	42	1,923	10	1,682	46	13,505	374	13,879
Non-employees:																							
From Temperate Zone	15	18	38	25	17	21	59	21	56	53	98	57	4	1	6	5	64	46	41	17	398	264	662
Others	67	190	288	445	178	430	600	623	337	886	667	321	......	......	79	114	436	790	326	674	2,978	4,473	7,451
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	77	704	92	1,950	63	2,336	57	1,793	153	1,663	102	1,259	16	19	19	494	77	1,933	134	1,728	790	13,879	14,669
Non-employees	33	257	63	733	38	608	80	1,223	109	1,223	155	988	5	......	11	193	110	1,226	58	1,000	662	7,451	8,113
GRAND TOTAL	110	961	155	2,683	101	2,944	137	3,016	262	2,886	257	2,247	21	19	30	687	187	3,159	192	2,728	1,452	21,330	22,782
TREATMENTS IN HOSPITAL DISPENSARIES:																							
Employees:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
From Temperate Zone	642	58	2,329	......	661	32	483	36	1,363	3	691	27	779	4	404	21	1,467	188	1,527	85	10,346	454	10,800
Others	3,832	299	38,863	866	19,085	252	15,101	2,212	26,965	285	2,472	122	9,465	2,768	3,996	590	13.490	506	12,530	625	145,799	8,525	154,324
Non-employees:																							
From Temperate Zone	61	116	179	165	54	65	103	90	467	637	194	480	198	123	44	186	766	588	307	425	2,373	2,875	5,248
Others	456	929	1,990	3,592	1,896	3,326	4,356	5,269	14,007	21,607	697	535	1,909	1,336	813	1,170	2,340	5,871	3,563	5,388	32,027	49,023	81,050
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	700	4,131	2,329	39,729	693	19,337	519	17,313	1,366	27,250	718	2,594	783	12,233	425	4,586	1,655	13,996	1,612	13,155	10,800	154,324	165,124
Non-employees	177	1,385	344	5,582	119	5,222	193	9,625	1,104	35,614	674	1,232	321	3,245	230	1,983	1,354	8,211	732	8,951	5,248	81,050	86,298
GRAND TOTAL	877	5,516	2,673	45,311	812	24,559	712	26,938	2,470	62,864	1,392	3,826	1,104	15,478	655	6,569	3,009	22,207	2,344	22,106	16,048	235,374	251,422
TREATMENTS IN FIELD DISPENSARIES:																							
Employees:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
From Temperate Zone	327	......	22	......	6	1	112	......	......	......	1,186	171	184	2	107	6	368	......	111	......	2,423	180	2,603
Others	7,337	34	14,875	426	320	33	19,205	740	......	......	10,509	775	8,315	2,513	2,277	264	21,962	73	12,527	56	97,327	4,914	102,241
Non-employees:																							
From Temperate Zone	......	1	......	......	3	8	13	3	......	......	408	452	2	6	4	9	3	12	......	1	433	492	925
Others	301	813	2	38	195	231	2,415	3,551	......	......	2,912	2,663	230	212	41	159	531	1,073	249	892	6,876	9,632	16,508
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	327	7,371	22	15,301	7	353	112	19,945	......	......	1,357	11,284	186	10,828	113	2,541	368	22,035	111	12,583	2,603	102,241	104,844
Non-employees	1	1,114	......	40	11	426	16	5,966	......	......	860	5,575	8	442	13	200	15	1,604	1	1,141	925	16,508	17,433
GRAND TOTAL	328	8,485	22	15,341	18	779	128	25,911	......	......	2,217	16,859	194	11,270	126	2,741	383	23,639	112	13,724	3,528	118,749	122,277

TOTAL NUMBER OF TREATMENTS IN HOSPITAL DISPENSARIES AND FIELD DISPENSARIES:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
Employees:																							
From Temperate Zone	969	58	2,351	......	667	33	595	36	1,363	3	1,877	198	963	6	511	27	1,835	188	1,638	85	12,769	634	13,403
Others	11,169	333	53,738	1,292	19,405	285	34,306	2,952	26,965	285	12,981	897	17,780	5,281	6,273	854	35,452	579	25,057	681	243,126	13,439	256,565
Non-employees:																							
From Temperate Zone	61	117	179	165	57	73	116	93	467	637	602	932	200	129	48	195	769	600	307	426	2,806	3,367	6,173
Others	757	1,742	1,992	3,630	2,091	3,557	6,771	8,820	14,007	21,607	3,609	3,198	2,139	1,548	854	1,329	2,871	6,944	3,812	6,280	38,903	58,655	97,558
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	1,027	11,502	2,351	55,030	700	19,690	631	37,258	1,366	27,250	2,075	13,878	969	23,061	538	7,127	2,023	36,031	1,723	25,738	13,403	256,565	269,968
Non-employees	178	2,499	344	5,622	130	5,648	209	15,591	1,104	35,614	1,534	6,807	329	3,687	243	2,183	1,369	9,815	733	10,092	6,173	97,558	103,731
GRAND TOTAL	1,205	14,001	2,695	60,652	830	25,338	840	52,849	2,470	62,864	3,609	20,685	1,298	26,748	781	9,310	3,392	45,846	2,456	35,830	19,576	354,123	373,699
NUMBER OF HOSPITAL DAYS:	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
Employees:																							
From Temperate Zone	374	78	1,032	11	699	2	628	5	1,559	44	834	60	103	......	95	.....	787	29	1,947	14	8,058	243	8,301
Others	6,160	83	27,717†	863	17,835	89	30,563	1,240	24,175	247	13,997‡	701	247	32	5,330	247	31,313	55	12,433	1,162	169,770	4,719	174,489
Non-employees:																							
From Temperate Zone	66	107	672	215	155	103	1,849	203	642	508	916	641	33	5	63	31	826	581	1,159	111	6,381	2,505	8,886
Others	388	905	4,358	5,405	1,542	2,927	6,527	6,300	3,299	9,019	8,844	1,964	......	......	1,191	910	4,225	3,777	5,183	5,043	35,557	36,250	71,807
Totals:	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Employees	452	6,243	1,043	28,580	701	17,924	633	31,803	1,603	24,422	894	14,698	103	279	95	5,577	816	31,368	1,961	13,595	8,301	174,489	182,790
Non-employees	173	1,293	887	9,763	258	4,469	2,052	12,827	1,150	12,318	1,557	10,808	38	......	94	2,101	1,407	8,002	1,270	10,226	8,886	71,807	80,693
GRAND TOTAL	625	7,536	1,930	38,343	959	22,393	2,685	44,630	2,753	36,740	2,451	25,506	141	279	189	7,678	2,223	39,370	3,231	23,821	17,187	246,296	263,483
NUMBER OF TREATMENTS ABOARD PASSENGER STEAMSHIPS	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	12,081
NUMBER OF TREATMENTS BY PORT MEDICAL OFFICERS	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	12,386
NUMBER OF SEAMEN AND APPLICANTS EXAMINED BY PORT MEDICAL OFFICERS	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	28,673
DEATHS, HOSPITALS:																							
Employees:																							
From Temperate Zone	2		1		4		......		3		......		......		......		1		1		......		12
Others	26		29		60		65		53		28		2		37		27		47		......		374
Non-employees:																							
From Temperate Zone	1		2		3		2		2		4		......		......		3		1		......		18
Others	11		38		33		89		45		35		......		8		60		44		......		363
Totals:																							
Employees	28		30		64		65		56		28		2		37		28		48		......		386
Non-employees	12		40		36		91		47		39		......		8		63		45		......		381
GRAND TOTAL	40		70		100		156		103		67		2		45		91		93		......		767
DEATHS, HOSPITAL DISPENSARIES:																							
Employees:																							
From Temperate Zone	......		......		......		......		......		......		......		......		......		......		......		......
Others	2		3		......		3		17		......		6		......		......		......		......		31
Non-employees:																							
From Temperate Zone	......		......		......		......		......		......		......		......		......		......		......		......
Others	1		8		......		8		72		......		3		1		......		......		......		93
Totals:																							
Employees	2		3		......		3		17		......		6		......		......		......		......		31
Non-employees	1		8		......		8		72		......		3		1		......		......		......		93
GRAND TOTAL	3		11		......		11		89		......		9		1		......		......		......		124

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* Including 47 patients treated in Line Hospitals.

† Including 201 days in Aracataca Line Hospital.

‡ Including 2,586 days in Sick Camps.

SUMMARY OF WORK DONE AND VITAL STATISTICS—*Concluded*

	Chiriqui Land Co.	Colombia Division	Cortes Development Company	Cia. Bananera Costa Rica	Cuban Divisions	Guatemala Division	Jamaica Division	Panama Division	Tela Railroad	Truxillo Railroad	Semi-Totals	Total
†DEATHS, FIELD DISPENSARIES:												
Employees:												
From Temperate Zone										3		3
Others	1	2	3	9	7	1	3	7		48		81
Non-employees:												
From Temperate Zone										1		1
Others	8		13	2	40	1		2		20		86
Totals:												
Employees	1	2	3	9	7	1	3	7		51		84
Non-employees	8		13	2	40	1		2		21		87
GRAND TOTAL	9	2	16	11	47	2	3	9		72		171
DEATHS, HOSPITALS AND ALL DISPENSARIES COMBINED:												
Employees:												
From Temperate Zone	2	1	4		3				1	4		15
Others	29	34	63	77	77	29	11	44	27	95		486
Non-employees:												
From Temperate Zone	1	2	3	2	2	4			3	2		19
Others	20	46	46	99	157	36	3	11	60	64		542
Totals:												
Employees	31	35	67	77	80	29	11	44	28	99		501
Non-employees	21	48	49	101	159	40	3	11	63	66		561
GRAND TOTAL	52	83	116	178	239	69	14	55	91	165		1,062
DEATHS, STEAMSHIP SERVICE:												
Passengers												4
Officers, crews and ships' laborers												2
TOTAL												6
GRAND TOTAL—DEATHS AMONG PERSONS DEPENDENT ON THE COMPANY FOR TREATMENT (Steamship service included):												1,068
											*Total, Excluding Jamaica Division	
REPATRIATIONS:												
Employees:												
From Temperate Zone		1	1									2
Others	10	38	35	15	7			7	49	15		176
Non-employees:												
From Temperate Zone												
Others												
Totals:												
Employees	10	39	36	15	7			7	49	15		178
Non-employees												
GRAND TOTAL	10	39	36	15	7			7	49	15		178

AVERAGE DAILY NUMBER OF PATIENTS IN HOSPITALS:												
Employees:												
From Temperate Zone	1.24	2.87	1.93	1.74	4.40	2.46	.28	.26	2.24	5.39	22.52	22.80
Others	17.15	78.52	49.24	87.37	67.09	40.38	.77	15.32	86.18	37.35	478.60	479.37
Non-employees:												
From Temperate Zone	.48	2.44	.71	5.64	3.16	4.28	.10	.26	3.87	3.49	24.31	24.41
Others	3.55	26.82	12.28	35.24	33.84	29.69	....	5.77	21.98	28.09	197.27	197.27
Totals:												
Employees	18.39	81.38	51.17	89.11	71.50	42.84	1.05	15.58	88.42	42.74	501.12	502.17
Non-employees	4.03	29.26	12.99	40.88	37.00	33.97	.10	6.03	25.85	31.58	221.58	221.68
GRAND TOTAL	22.42	110.64	64.15	129.99	108.50	76.80	1.15	21.61	114.27	74.32	722.70	723.85
AVERAGE DAILY NUMBER OF TREATMENTS IN HOSPITAL DISPENSARIES AND FIELD DISPENSARIES:												
Employees:												
From Temperate Zone	2.82	6.46	1.92	1.73	3.75	5.70	2.66	1.48	5.56	4.73	34.16	36.82
Others	31.60	151.18	54.09	102.36	74.86	38.13	63.35	19.58	98.99	70.71	641.49	704.85
Non-employees:												
From Temperate Zone	.49	.95	.36	.57	3.03	4.21	.90	.67	3.76	2.01	16.05	16.96
Others	6.87	15.45	15.52	42.83	97.84	18.70	10.13	5.99	26.96	27.73	257.89	268.02
Totals:												
Employees	34.42	157.64	56.02	104.09	78.62	43.83	66.02	21.06	104.54	75.44	675.65	741.67
Non-employees	7.36	16.39	15.87	43.41	100.87	22.91	11.03	6.66	30.73	29.74	273.94	284.98
GRAND TOTAL	41.78	174.03	71.89	147.50	179.49	66.74	77.05	27.72	135.27	105.18	949.60	1026.65
DEATH RATE PER THOUSAND EMPLOYEES:												
From Temperate Zone	17.39	7.87	25.64	....	5.59	....	....	....	4.24	21.74	8.65	8.26
Others	14.19	6.01	14.70	15.77	6.98	8.32	.91	20.39	6.00	21.53	11.19	8.90
TOTAL	14.36	6.05	15.08	15.30	6.92	7.92	.90	19.87	5.92	21.54	11.09	8.88
AVERAGE NUMBER OF HOSPITAL DAYS ANNUALLY, PER EMPLOYEE:												
From Temperate Zone	3.93	8.21	4.49	4.22	2.99	5.14	1.26	1.70	3.46	10.66	4.73	4.57
Others	3.06	5.05	4.18	6.51	2.21	4.22	.02	2.58	6.98	3.08	4.10	3.20
TOTAL	3.10	5.12	4.19	6.45	2.25	4.26	.03	2.56	6.80	3.38	4.13	3.24
HOSPITAL ADMISSION RATE ANNUALLY, PER THOUSAND EMPLOYEES:												
From Temperate Zone	670	724	404	380	285	586	195	339	326	728	446	435
Others	345	345	545	367	151	361	1	229	430	392	326	254
TOTAL	362	353	540	368	157	372	3	232	425	405	331	260
AVERAGE NUMBER DISPENSARY TREATMENTS ANNUALLY, PER EMPLOYEE:												
From Temperate Zone	8.93	18.51	4.49	4.21	2.54	11.93	11.82	9.61	8.57	9.36	7.17	7.38
Others	5.63	9.73	4.59	7.63	2.47	3.98	1.90	3.30	8.01	5.83	5.50	4.70
TOTAL	5.81	9.92	4.59	7.53	2.47	4.36	1.97	3.46	8.04	5.97	5.57	4.79
AVERAGE NUMBER OF EMPLOYEES NON-EFFECTIVE, PER THOUSAND EMPLOYEES:												
From Temperate Zone	10.78	22.60	12.37	11.60	8.19	14.14	3.45	4.64	9.49	29.29	12.98	12.55
Others	8.39	13.88	11.49	17.90	6.08	11.58	.06	7.10	19.16	8.46	11.27	8.78
TOTAL	8.52	14.07	11.52	17.71	6.18	11.70	.08	7.04	18.68	9.30	11.34	8.90
AVERAGE NUMBER OF EMPLOYEES PARTIALLY NON-EFFECTIVE, PER THOUSAND EMPLOYEES:												
From Temperate Zone	24.52	50.87	12.31	11.53	6.98	32.76	32.46	26.43	23.56	25.71	19.69	20.26
Others	15.47	26.73	12.62	20.97	6.79	10.94	5.22	9.07	22.01	16.02	15.11	12.91
TOTAL	15.95	27.25	12.61	20.69	6.80	11.97	5.40	9.51	22.09	16.41	15.29	13.15

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* See Explanatory Notes on page 320.

† Including "Other Deaths"—See Appendix of table on page 288.

RECORD OF HOSPITALS

			Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
			T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Remaining from last year	Emp.	M.	3	21	2	84	4	45	3	57	.....	45	1	41	.....	1	1	13	1	98	6	42	21	447	468
		F.	.....	1	.....	.....	.....	2	.....	2	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	4	.....	10	10
	Non-emp.	M.	.....	.....	.....	12	.....	8	3	26	1	4	5	14	.....	.....	1	3	12	25	.....	21	22	113	135
		F.	.....	4	1	15	.....	14	1	18	1	21	.....	6	.....	.....	.....	3	3	6	.....	15	6	102	108
Admitted this year	Emp.	M.	70	664	88	1,806*	58	2,277	52	1,632	148	1,594	94	1,166	16	15	18	439	74	1,825	124	1,640	742	13,058	13,800
		F.	4	18	2	60	1	12	2	102	5	24	7	52	.....	3	.....	41	2	10	4	42	27	364	391
	Non-emp.	M.	15	67	38	276	17	170	56	574	55	333	93	653	4	.....	5	76	52	411	41	305	376	2,865	3,241
		F.	18	186	24	430	21	416	20	605	52	865	57	315	1	.....	5	111	43	784	17	659	258	4,371	4,629
Discharged	Emp.	M.	73	672	86	1,846*	61	2,283	55	1,627	142	1,608	92	1,183	16	16	18	428	75	1,848	125	1,651	743	13,162	13,905
		F.	4	19	2	60	1	14	2	104	5	24	7	49	.....	3	.....	42	2	10	4	43	27	368	395
	Non-emp.	M.	15	66	36	277	17	175	57	589	54	334	96	663	4	.....	6	75	62	431	41	313	388	2,923	3,311
		F.	18	186	25	438	20	425	20	618	53	879	57	317	1	.....	5	112	43	787	17	665	259	4,427	4,686
Remaining	Emp.	M.	.....	13	4	44	1	39	.....	62	6	31	3	24	.....	.....	1	24	.....	75	5	31	20	343	363
		F.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	3	.....	6	6
	Non-emp.	M.	.....	1	2	11	.....	3	2	11	2	3	2	4	.....	.....	.....	4	2	5	.....	13	10	55	65
		F.	.....	4	.....	7	1	5	1	5	.....	7	.....	4	.....	.....	.....	2	3	3	.....	9	5	46	51
Died	Emp.		2	26	1	29	4	60	.....	65	3	53	.....	28	.....	2	.....	37	1	27	1	47	12	374	386
	Non-emp.		1	11	2	38	3	33	2	89	2	45	4	35	.....	.....	.....	8	3	60	1	44	18	363	381
Repatriated	Emp.		.....	6	1	35	.....	33	.....	15	.....	7	.....	.....	.....	.....	.....	5	.....	49	.....	15	1	165	166
	Non-emp.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total number of hospital days	Emp.	M.	374	6,160	1,032	27,717*	699	17,835	628	30,563	1,559	24,175	834	13,997†	103	247	95	5,330	787	31,313	1,947	12,433	8,058	169,770	177,828
		F.	78	83	11	863	2	89	5	1,240	44	247	60	701	.....	32	.....	247	29	55	14	1,162	243	4,719	4,962
	Non-emp.	M.	66	388	672	4,358	155	1,542	1,849	6,527	642	3,299	916	8,844	33	.....	63	1,191	826	4,225	1,159	5,183	6,381	35,557	41,938
		F.	107	905	215	5,405	103	2,927	203	6,300	508	9,019	641	1,964	5	.....	31	910	581	3,777	111	5,043	2,505	36,250	38,755
Operations with general anesthesia	Emp.		2	21	.....	19	1	34	2	53	22	175	24	125	.....	5	.....	35	10	97	3	77	64	641	705
	Non-emp.		4	24	.....	19	2	29	8	54	20	326	42	151	.....	.....	.....	17	17	111	6	41	99	772	871
Operations with or without local anesthesia	Emp.		66	1,409	10	1,461	10	147	11	1,467	46	1,130	30	458	2	.....	2	165	29	883	18	806	224	7,926	8,150
	Non-emp.		24	245	28	449	11	74	90	457	30	406	38	185	1	.....	.....	46	83	367	38	321	343	2,550	2,893

* Including patients admitted to Line Hospitals (47 cases, with 201 hospital days).
† Including 2,586 days in Sick Camps.

RECORD OF HOSPITAL DISPENSARIES

			Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
			T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Number of treatments administered	Emp.	M.	642	3,832	2,329	38,863	661	19,085	483	15,101	1,363	26,965	691	2,472	779	9,465	404	3,996	1,467	13,490	1,527	12,530	10,346	145,799	156,145
		F.	58	299	.....	866	32	252	36	2,212	3	285	27	122	4	2,768	21	590	188	506	85	625	454	8,525	8,979
	Non-emp.	M.	61	456	179	1,990	54	1,896	103	4,356	467	14,007	194	697	198	1,909	44	813	766	2,340	307	3,563	2,373	32,027	34,400
		F.	116	929	165	3,592	65	3,326	90	5,269	637	21,607	480	535	123	1,336	186	1,170	588	5,871	425	5,388	2,875	49,023	51,898
Patients sent to hospitals	Emp.	M.	48	514	77	1,375	*	*	32	297	148	1,628	94	1,166	16	15	18	439	74	848	124	1,640	631	7,922	8,553
		F.	.....	11	2	47	*	*	2	25	5	24	7	52	.....	3	.....	41	2	8	4	42	22	253	275
	Non-emp.	M.	11	46	38	276	*	*	53	438	55	337	93	653	4	.....	5	66	52	368	41	305	352	2,489	2,841
		F.	6	138	24	428	*	*	15	520	52	870	57	315	1	.....	5	102	43	541	17	659	220	3,573	3,793

* Not recorded.

RECORD OF HOSPITAL DISPENSARIES—*Concluded*

			Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
			T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Visits to lodgings	Emp.	M.	....	....	10	103	*	*	60	427	17	100	2	....	113	175	....	....	37	....	11	....	250	805	1,055
		F.	....	....	....	3	*	*	....	122	....	2	....	....	1	52	....	....	17	....	1	....	19	179	198
	Non-emp.	M.	....	2	18	4	*	*	44	136	14	108	6	....	56	30	1	....	25	15	11	6	175	301	476
		F.	5	1	44	....	*	*	54	191	30	215	3	13	49	51	....	6	38	15	7	13	230	505	735
Operations with general anesthesia	Emp.		1	....	....	1	....	1	....	2	....	....	....	....	....	2	....	....	....	....	....	....	1	6	7
	Non-emp.		1	3	....	5	....	....	1	4	....	....	....	....	....	....	....	....	....	....	....	....	2	12	14
Operations with or without local anesthesia	Emp.		90	1,539	31	1,472	75	1,875	38	4,754	236	4,368	23	14	7	233	8	562	266	1,264	365	5,347	1,139	21,428	22,567
	Non-emp.		31	497	23	236	81	691	13	1,730	543	9,984	297	127	20	1,339	3	192	260	887	157	3,586	1,428	19,269	20,697
Died	Emp.		....	2	....	3	....	....	....	3	....	17	....	....	....	6	....	....	....	....	....	....	....	31	31
	Non-emp.		....	1	....	8	....	....	....	8	....	72	....	....	....	3	....	1	....	....	....	....	....	93	93
Repatriated	Emp.		....	4	....	3	1	2	....	....	....	....	....	....	....	....	....	2	....	....	....	....	1	11	12
	Non-emp.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

RECORD OF FIELD DISPENSARIES

			Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
			T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Number of treatments administered	Emp.	M.	327	7,337	22	14,875	6	320	112	19,205	....	....	1,186	10,509	184	8,315	107	2,277	368	21,962	111	12,527	2,423	97,327	99,750
		F.	....	34	....	426	1	33	....	740	....	....	171	775	2	2,513	6	264	....	73	....	56	180	4,914	5,094
	Non-emp.	M.	....	301	....	2	3	195	13	2,415	....	....	408	2,912	2	230	4	41	3	531	....	249	433	6,876	7,309
		F.	1	813	....	38	8	231	3	3,551	....	....	452	2,663	6	212	9	159	12	1,073	1	892	492	9,632	10,124
Number of surgical treatments	Emp.	M.	3,023		5,432		14		4,838		....	....	3,478		2,729		472		6,355		4,785		....	....	31,126
		F.	8		169		1		164		....	....	131		551		57		19		5		....	....	1,105
	Non-emp.	M.	41		....		9		349		....	....	673		81		11		243		53		....	....	1,460
		F.	164		16		4		453		....	....	544		50		45		292		174		....	....	1,742
Total number of surgical treatments			3,236		5,617		28		5,804		....	....	4,826		3,411		585		6,909		5,017		....	....	35,433
Number of medical treatments	Emp.	M.	4,641		9,465		312		14,479		....	....	8,217		5,770		1,912		15,975		7,853		....	....	68,624
		F.	26		257		33		576		....	....	815		1,964		213		54		51		....	....	3,989
	Non-emp.	M.	260		2		189		2,079		....	....	2,647		151		34		291		196		....	....	5,849
		F.	650		22		235		3,101		....	....	2,571		168		123		793		719		....	....	8,382
Total number of medical treatments			5,577		9,746		769		20,235		....	....	14,250		8,053		2,282		17,113		8,819		....	....	86,844
GRAND TOTAL			8,813		15,363		797		26,039		....	....	19,076		11,464		2,867		24,022		13,836		....	....	122,277
Patients sent to hospitals	Emp.	M.	25	440	11	387	....	1	20	1,335	....	....	12	246	....	32	....	967	....	977	2	509	70	4,894	4,964
		F.	....	1	....	13	....	....	....	77	....	....	2	13	....	10	....	219	....	2	....	2	2	337	339
	Non-emp.	M.	....	11	....	....	....	....	3	136	....	....	2	9	....	....	....	24	....	43	....	23	5	246	251
		F.	1	80	....	2	....	....	5	85	....	....	4	51	....	....	....	101	....	243	....	38	10	600	610
Visits to lodgings	Emp.	M.	1,730		203		9		1,873		....	....	1,195		452		162		35		2,399		....	....	8,058
		F.	5		43		2		79		....	....	294		89		37		23		52		....	....	624
	Non-emp.	M.	39		....		3		171		....	....	512		48		18		9		151		....	....	951
		F.	308		....		7		712		....	....	534		30		47		18		571		....	....	2,227
Died	Emp.		....	....	....	2	....	1	....	2	....	....	....	....	....	3	....	4	....	....	....	....	....	12	12
	Non-emp.		....	4	....	....	....	4	....	1	....	....	....	....	....	....	....	2	....	....	....	....	....	11	11

NOTE.—The Banes Division and the Preston Division (Cuban Divisions) did not operate any Field Dispensaries (i.e., Dispensaries in charge of dispensers and not physicians) during 1931.

DEATHS BY AGE, NATIVITY AND SEX

Age and Sex:		Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
		T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Under 1 year	M.	...	...	...	2	...	...	...	6	...	...	...	2	...	...	...	9	...	...	...	35	...	...	...	...	...	...	...	2	...	...	...	1	...	...	...	6	...	...	...	4	...	...	...	67	67
	F.	...	...	...	3	...	...	...	...	...	...	...	3	...	...	...	12	...	...	...	20	...	...	...	2	...	...	...	...	...	...	...	2	...	...	...	3	...	...	...	4	...	...	...	49	49
1 to 5 years	M.	...	...	...	3	...	...	...	4	...	...	...	4	...	...	...	5	...	...	...	21	...	...	...	2	...	...	...	1	...	...	...	1	...	...	...	8	...	...	...	3	...	...	...	52	52
	F.	...	...	...	3	...	...	...	...	...	...	1	4	...	...	...	4	...	...	...	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	...	...	...	1	...	...	1	39	40
6 to 10 years	M.	...	...	...	...	...	...	...	2	...	...	...	2	...	...	...	1	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	2	...	...	...	11	11
	F.	...	...	...	...	...	...	...	2	...	...	...	4	...	...	...	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	11	11
11 to 20 years	M.	...	3	...	1	...	2	...	4	...	14	...	1	...	10	...	5	...	8	...	4	...	1	...	1	...	1	...	...	...	1	...	...	...	6	...	2	...	4	...	...	...	50	...	18	68
	F.	...	...	...	...	...	...	...	6	...	...	...	2	...	...	...	7	...	...	...	6	...	...	...	5	...	1	...	...	...	...	...	...	...	...	...	2	...	...	...	2	...	1	...	30	31
21 to 30 years	M.	1	12	...	2	...	12	...	4	1	22	1	3	...	16	...	9	...	20	...	...	...	16	1	3	...	1	...	...	...	3	...	...	...	11	...	5	2	28	1	8	4	141	3	34	182
	F.	...	...	...	1	...	...	...	5	...	...	...	11	...	...	...	6	...	1	...	7	...	...	...	7	...	2	...	...	...	...	...	1	...	...	...	9	...	...	...	8	...	3	...	55	58
31 to 40 years	M.	...	6	...	...	...	10	2	1	3	16	...	2	...	13	...	6	...	15	1	2	...	7	1	7	...	1	...	...	...	8	...	3	...	4	...	5	...	17	...	3	3	97	4	29	133
	F.	...	...	...	3	...	...	...	2	...	...	...	1	...	2	...	7	...	...	1	17	...	...	...	3	...	...	...	...	...	1	...	...	...	...	...	5	...	...	...	5	...	3	1	43	47
41 to 50 years	M.	1	6	1	1	...	7	...	1	...	8	...	...	...	11	...	5	1	15	...	2	...	3	1	4	...	...	...	...	...	14	...	1	...	2	1	1	1	3	...	1	3	69	3	16	91
	F.	...	...	...	...	...	...	...	2	...	...	...	3	...	...	...	3	...	...	...	5	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	1	...	15	16
51 to 60 years	M.	...	2	...	1	...	2	...	3	...	1	...	...	...	15	...	6	2	11	...	1	...	2	...	1	...	3	...	...	...	8	...	...	...	3	1	1	...	3	...	2	2	50	1	15	68
	F.	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	3	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	1	1	7	9
61 to 70 years	M.	...	...	...	...	...	1	...	...	...	2	...	...	...	6	...	4	...	2	...	1	...	...	1	...	...	...	...	...	...	6	...	1	...	...	1	1	...	...	...	...	...	17	2	7	26
	F.	...	...	...	...	...	...	...	2	...	...	...	1	...	...	...	2	...	...	...	7	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	13	14
Over 70 years	M.	...	...	...	...	...	...	...	1	...	...	1	1	...	2	1	2	...	3	...	2	...	...	...	...	...	...	...	...	...	2	...	...	1	...	...	1	...	...	...	...	1	7	2	7	17
	F.	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3
Unknown or Unstated	M.	...	...	...	...	1	...	...	...	...	...	...	1	...	1	...	1	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	40	1	13	2	44	1	16	63
	F.	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	3	...	1	...	5	6
SEMI-TOTALS	M.	2	29	1	10	1	34	2	26	4	63	2	16	...	74	1	53	3	76	1	72	...	29	4	18	...	6	...	3	...	42	...	7	1	27	3	31	4	95	2	36	15	475	16	272	778
	F.	...	...	...	10	...	...	...	20	...	...	1	30	...	3	1	46	...	1	1	85	...	...	...	18	...	5	...	...	...	2	...	4	...	...	...	29	...	...	...	28	...	11	3	270	284
TOTALS		2	29	1	20	1	34	2	46	4	63	3	46	...	77	2	99	3	77	2	157	...	29	4	36	...	11	...	3	...	44	...	11	1	27	3	60	4	95	2	64	15	486	19	542	1,062

APPENDIX

	Chiriqui Emp. T.	Chiriqui Emp. O.	Chiriqui Non-Emp. T.	Chiriqui Non-Emp. O.	Colombia Emp. T.	Colombia Emp. O.	Colombia Non-Emp. T.	Colombia Non-Emp. O.	Cortes Emp. T.	Cortes Emp. O.	Cortes Non-Emp. T.	Cortes Non-Emp. O.	Cia. Bananera Emp. T.	Cia. Bananera Emp. O.	Cia. Bananera Non-Emp. T.	Cia. Bananera Non-Emp. O.	Cuban Emp. T.	Cuban Emp. O.	Cuban Non-Emp. T.	Cuban Non-Emp. O.	Guatemala Emp. T.	Guatemala Emp. O.	Guatemala Non-Emp. T.	Guatemala Non-Emp. O.	Jamaica Emp. T.	Jamaica Emp. O.	Jamaica Non-Emp. T.	Jamaica Non-Emp. O.	Panama Emp. T.	Panama Emp. O.	Panama Non-Emp. T.	Panama Non-Emp. O.	Tela Emp. T.	Tela Emp. O.	Tela Non-Emp. T.	Tela Non-Emp. O.	Truxillo Emp. T.	Truxillo Emp. O.	Truxillo Non-Emp. T.	Truxillo Non-Emp. O.	Semi-Totals Emp. T.	Semi-Totals Emp. O.	Semi-Totals Non-Emp. T.	Semi-Totals Non-Emp. O.	Total
Deaths, Hospitals	2	.26	1	11	1	29	2	38	4	60	3	33	...	65	2	89	3	53	2	45	...	28	4	35	...	2	...	...	...	37	...	8	1	27	3	60	1	47	1	44	12	374	18	363	767
Deaths, Hospital Dispensaries	...	2	...	1	...	3	...	8	...	...	...	...	...	3	...	8	...	17	...	72	...	...	...	...	...	6	...	3	...	...	...	1	...	...	...	...	...	...	...	...	...	31	...	93	124
Deaths, Field Dispensaries	...	...	...	4	...	2	...	...	...	1	...	4	...	2	...	1	...	...	...	...	...	...	...	...	...	3	...	...	...	4	...	2	...	...	...	...	...	...	...	...	...	12	...	11	23
*Deaths, Others	...	1	...	4	...	...	...	...	...	2	...	9	...	7	...	1	...	7	...	40	...	1	...	1	...	...	...	...	...	3	...	...	...	...	...	...	3	48	1	20	3	69	1	75	148

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* Deaths occurring within the Company property, of persons who did not receive medical attendance.

DEATHS BY NATIVITY

Nativity	Chiriqui Land Co.	Colombia Division	Cortes Development Co.	Cia. Bananera Costa Rica	Cuban Divisions	Guatemala Division	Jamaica Division	Panama Division	Tela Railroad	Truxillo Railroad	Total
Austria		1									1
Barbados					1			3	1		5
Belgium		1									1
British Honduras			3			2			3	1	9
British West Indies (other than Jamaica and Barbados)				5	1			4			10
Canary Islands					1						1
China		2		2	1				1		6
Colombia		75		2				2			79
Costa Rica	8			88				2			98
Cuba	1				157						158
Dutch West Indies		2									2
England			1	1							2
French West Indies	1		1					1			3
Germany						1					1
Guatemala			4			40			2		46
Haiti					49						49
Honduras			59			1			70	120	250
India							3				3
Jamaica	6		2	57	19	6	11	28	3	3	135
Mexico	1		1			1					3
Nicaragua	13		2	19				3	1	5	43
Norway		1									1
Palestine			1								1
Panama	19			2				12			33
Porto Rico					4						4
Portugal									1		1
Roumania										1	1
Salvador			35			15			6	11	67
Spain	1		4		4	1			1	2	13
Turkey										1	1
United States	2		3	1	1	2			2	2	13
Venezuela		1									1
Virgin Islands					1						1
Unknown or unstated				1						19	20
Totals	52	83	116	178	239	69	14	55	91	165	1,062

RESULTS OF MALARIA BLOOD SURVEYS—1931

Divisions	Number of Persons in Camps or Units				Number of Persons Examined				Number of Positives of Each Type Found During Surveys												Total Number Positive				Percentage Positive				Total of Various Types				Percentage of Various Types			
									Estivo-Autumnal			Tertian			Quartan			Mixed																		
	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total	E.A.	Tertian	Quartan	Mixed	E.A.	Tertian	Quartan	Mixed
Chiriqui Land Co.	*	*	*	*	2582	1197	989	4768	108	37	55	110	37	60	1	1	....	1	1	1	220	76	116	412	8.5	6.3	11.7	8.6	200	207	2	3	48.5	50.2	0.5	0.7
Colombia Division	*	*	*	*	836	212	437	1485	106	22	67	92	22	70	....	....	....	....	....	3	198	44	140	382	23.7	20.8	32.0	25.7	195	184	...	3	51.0	48.2	0.0	0.8
Cortes Development Co.	*	*	*	*	3058	1240	1179	5477	※	※	※	※	※	※	※	※	※	※	※	※	561	184	237	982	18.4	14.8	20.1	17.9	526	423	28	5	53.6	43.1	2.9	0.5
Cia. Bananera de Costa Rica	*	*	*	*	2945	1431	1140	5516	238	98	121	6	7	12	....	....	....	....	....	....	244	105	133	482	8.3	7.3	11.7	8.7	457	25	...	...	94.8	5.2	0.0	0.0
Cuban Divisions Banes	2149	1895	3116	7160	702	894	1278	2874	10	20	20	....	....	....	....	....	....	....	....	....	10	20	20	50	1.4	2.2	1.6	1.7	50	....	...	...	100.0	0.0	0.0	0.0
Preston	1037	738	1058	2833	269	317	414	1000	24	35	39	....	....	....	....	....	....	....	....	....	24	35	39	98	8.9	11.0	9.4	9.8	98	....	...	...	100.0	0.0	0.0	0.0
Guatemala Division	*	*	*	*	※	※	※	4710	173	76	87	200	92	146	19	9	8	22	12	43	414	189	284	887	※	※	※	18.8	336	438	36	77	37.9	49.4	4.1	8.7
Panama Division	*	*	*	*	※	※	※	4591	※	※	※	※	※	※	※	※	※	※	※	※	※	※	※	501	※	※	※	10.9	465	16	15	5	92.8	3.2	3.0	1.0
Tela Railroad Co.	*	*	*	*	7446	2640	2379	12465	422	121	107	249	80	74	57	16	10	5	....	8	733	217	199	1149	9.8	8.2	8.4	9.2	650	403	83	13	56.6	35.1	7.2	1.1
Truxillo Railroad Co.	*	*	*	*	5955	3594	3368	12917	※	※	※	※	※	※	※	※	※	※	※	※	1222	676	872	2770	20.5	18.8	25.9	21.4	1906	864	...	...	68.8	31.2	0.0	0.0
TOTAL—All Divisions	※	※	※	※	※	※	※	55803	※	※	※	※	※	※	※	※	※	※	※	※	※	※	※	7713	※	※	※	13.8	4883	2560	164	106	63.3	33.2	2.1	1.4

* No statistics of the actual or approximate number of inhabitants were reported.

※ The reports submitted were not sufficiently detailed to complete these statistics.

RESULTS OF MALARIA BLOOD SURVEYS—1931—*Concluded*

Divisions	Number of Persons in Camps or Units				Number of Persons Examined				Number of Positives of Each Type Found During Survey												Total Number Positive				Percentage Positive				Total of Various Types				Percentage of Various Types			
									Estivo-Autumnal			Tertian			Quartan			Mixed																		
	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Adult Male	Adult Female	Children	Total	Adult Male	Adult Female	Children	Total	E.A.	Tertian	Quartan	Mixed	E.A.	Tertian	Quartan	Mixed
Total—Omitting Panama Division	*	*	*	*	*	*	*	51212	*	*	*	*	*	*	*	*	*	*	*	*	3626	1546	2040	7212	*	*	*	14.1	4418	2544	149	101	61.3	35.2	2.1	1.4
Total—Omitting Panama and Guatemala Divisions	*	*	*	*	23793	11525	11184	46502	*	*	*	*	*	*	*	*	*	*	*	*	3212	1357	1756	6325	13.5	11.8	15.7	13.6	4082	2106	113	24	64.5	33.3	1.8	0.4
Total—Omitting Cortes, Panama, and Truxillo Divisions	*	*	*	*	*	*	*	32818	1081	409	496	657	238	362	77	26	18	28	13	55	1843	686	931	3460	*	*	*	10.5	1986	1257	121	98	57.4	36.3	3.5	2.8
Percentage of various types in each group									63.5	67.0	63.2	32.0	29.4	33.4	4.1	3.4	1.5	0.5	0.2	1.9																
Total—Omitting Cortes, Guatemala, Panama and Truxillo Divisions	*	*	*	*	14780	6691	6637	28108	908	333	409	457	146	216	58	17	10	8	1	12	1429	497	647	2573	9.7	7.4	9.7	9.2	1650	819	85	21	64.1	31.8	3.3	0.8
Percentage of persons, in each group, positive for each type									6.1	5.0	6.2	3.1	2.2	3.3	0.4	0.3	0.2	0.1	0.1	0.2																

NOTE.—The Tela Railroad Company considered those individuals up to and including 10 years of age as "Children;" while the Cortes Development Company considered any individuals up to 14 years of age as "Children." The other Divisions failed to state the line of division between children and adults.

CLASSIFICATION OF DEATHS BY DISEASE

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
EPIDEMIC OR INFECTIOUS DISEASES:																																																	
Typhoid fever (abdominal typhoid and paratyphoid):																																																	
Typhoid fever						8	2	7		1				6		3		2		3		1	1	1										2						1		20	3	15	38		20	3	15
Paratyphoid fevers						1		1						1																												2		1	3		2		1
Malarial fever or cachexia:																																																	
Estivo-autumnal			1		1			2		1		5				1		6		11		2	2	4						1					1	3					1	10	4	26	41	1	7	4	20
Tertian											1											1		2												1						1	1	3	5		1	1	3
Clinical				1						1		2				1										2		1														3		5	8		1		3
Cachexia										2										2																						2		2	4		2		
Hemoglobinuric fever		3								3				4		3		1		1		3		3						1				3			1	4		3	1	22		10	33	1	20		10
Influenza (complications):																																																	
Pneumonia														5		2										2				1				1		1		1				10		3	13		8		2
Bronchitis												1																																1	1				
Heart disease																														1												1			1		1		
Meningitis																																				1								1	1				1

Dysentery:																																																	
Amebic										5		2		1		2								1												1						6		6	12		6		6
Bacillary																		1																1								2			2		2		
Ictero-hemorrhagica spirochetosis						1		2																																		1		2	3		1		2
Leprosy																1																												1	1				1
Erysipelas												1																																1	1				1
Purulent or septicemic infection		2				1		1		1				2				2		1										2				1				1		2		12		4	16		12		3
Tetanus				1						1		1				1		1														1				2						2		6	8		2		6
Mycoses																		1																								1			1		1		
Tuberculosis of the respiratory system:																																																	
Acute pulmonary tuberculosis						1		1		3				3		6		8		4		2		2		2				3				1		2				1		23		16	39		19		10
Other forms of tuberculosis of the respiratory organs		4										1						1		1																		4				9		2	11		8		1
Tuberculosis of the meninges or of the central nervous system																		1																1								2			2		2		
Tuberculosis of the intestines or peritoneum																			1	1																							1	1	2			1	
Tuberculosis of other organs and structure:																																																	
Tuberculosis of the genitourinary system										1				1																												2			2		2		
Disseminated tuberculosis:																																																	
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary)																		1												1										1		2		1	3		2		1
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):																																																	
Primary																		1																								1			1		1		
Tertiary									1	1						1		1																							1	2		1	4	1	2		1
Hereditary								1								1																1												3	3				1
Period not specified																														5												5			5		5		
Gonococcal infection, except that of the eye or adnexa																														1												1			1		1		
GENERAL DISEASES NOT INCLUDED ABOVE:																																																	
Cancer or other malignant tumors of the stomach and liver:																																																	
Cancer of the stomach						2								2				1				1																				6			6		6		
Cancer of the liver and gall bladder														1		1	1			1																					1	1		2	4	1	1		1
Cancer or other malignant tumors of the peritoneum, intestines and rectum:																																																	
Cancer of the mesentery and peritoneum																1																												1	1				1
Cancer of the intestines (except rectum)										1																																1			1		1		
Cancer of the rectum and anus																		1																								1			1				
Others																														1												1			1		1		
Cancer or other malignant tumors of the female genital organs:																																																	
Cancer of the uterus															1					1																				1			1	2	3			1	1
Others																1																												1	1				1
Cancer or other malignant tumors of the breast																1																												1	1				1
Cancer or other malignant tumors of other or unspecified organs:																																																	
Cancer of the lung and pleura																1		1																								1		1	2		1		1
Cancer of the pancreas																								1																				1	1				1
Cancer of the prostate														1																												1			1		1		
Cancer of the brain																																						1				1			1		1		
Benign tumors and tumors not returned as malignant (except benign or non-specified tumors of the ovary and uterus):																																																	
Tumors of the prostate																		1																								1			1				
Tumor of other location																		1		1																						1		1	2				1
Diabetes																		1		1																1						1		2	3		1		2
Anemia, chlorosis:																																																	
Pernicious anemia														1									1	1																		1	1	1	3		1	1	1
Other anemias and chlorosis																								2												1								3	3				3
Leukemia and Hodgkin's disease:																																																	
Leukemia		1																																		1						1		1	2		1		1
Hodgkin's disease																		1				1																				2			2		1		
Alcoholism (acute or chronic)														1																												1			1				
Other general diseases:																																																	
Autointoxications				1				2																																				3	3				3
Hemophilia																				1																								1	1				1
Others																1																												1	1				1
DISEASES OF THE NERVOUS SYSTEM AND OF THE ORGANS OF SPECIAL SENSE:																																																	
Encephalitis										1						1		1																1								3		1	4		3		1

CLASSIFICATION OF DEATHS BY DISEASE—*Continued*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
DISEASES OF THE NERVOUS SYSTEM AND OF THE ORGANS OF SPECIAL SENSE—Concluded:																																																	
Meningitis:																																																	
Simple				1						2				2		3						2																				6		4	10		6		3
Non-epidemic cerebro-spinal meningitis																																		1		1		4		2		5		3	8		5		3
Other diseases of the spinal cord:																																																	
Acute ascending spinal paralysis (Landry's disease)												1																																1	1				1
Myelitis																																								1				1	1				1
Cerebral hemorrhage, apoplexy:																																																	
Cerebral hemorrhage						1						1		4						2				1						1				1		1				1		7		6	13		7		4
Cerebral thrombosis and embolism								1																																				1	1				1
Paralysis (without specified cause):																																																	
Hemiplegia																																						1				1			1		1		
General paralysis (of the insane)																		1																								1			1		1		
Epilepsy						1																																				1			1				
Infantile convulsions (under 5 years of age)																																				2								2	2				2
Softening of the brain																								1																				1	1				1
Other diseases of the nervous system								1																														1				1		1	2		1		
Diseases of the organs of hearing and the mastoid process:																																																	
Diseases of the mastoid process																1																												1	1				1
DISEASES OF THE CIRCULATORY SYSTEM:																																																	
Pericarditis																3				1														1				1				2		4	6		2		4
Acute endocarditis and myocarditis:																																																	
Acute endocarditis																																						1		2		1		2	3		1		2
Acute myocarditis								2								1		1								1							1							1	1	2		4	7	1	2		4
Angina pectoris																		1		1																						1		1	2				
Other diseases of the heart:																																																	
Chronic endocarditis		1				1		1								1		2		3																						4		5	9		3		2
Acute myocarditis		2												12	1	7		2		1						2				2						1				2		20	1	11	32		15	1	10
Other chronic diseases of the heart		1		1		5		2						3		2		4		3										3								2				18		8	26		14		5
Aneurism																1		4		1																						4		2	6		4		2
Atheroma and other diseases of the arteries								1								1		2		2																						2		4	6		1		1
Embolism and thrombosis (except cerebral)		1															1																								1	1			2	1	1		
Diseases of the lymphatic system (lymphangitis, etc.)																		1																								1			1		1		
DISEASES OF THE RESPIRATORY SYSTEM:																																																	
Bronchitis:																																																	
Acute																3		1		2				1																		1		6	7				3
Chronic												1																																1	1				1
Not otherwise defined (under 5 years of age)																				2																								2	2				
Bronchopneumonia (including capillary bronchitis):																																																	
Bronchopneumonia	1	1		4				2		1		3		1		8		5		25				1						2		3		1		7		1		5	1	12		58	71	1	9		36
Pneumonia:																																																	
Lobar		3		1		1		1	1	18		4		8		6		1		2		10		7						2				6	1	4		10		6	1	59	1	31	92	1	59	1	28
Not otherwise specified		1		3												1																										1		4	5				1
Pleurisy:																																																	
Pleurisy																		1																								1			1		1		
Empyema of thoracic cavity		1						1																																		1		1	2		1		1
Gangrene of the lung																	1																								1				1	1			
Asthma		1												1																												2			2		1		
Other diseases of the respiratory system (tuberculosis excepted):																																																	
Others										1				1																								1				3			3		3		

Diseases of the Digestive System:																																												
Diseases of the pharynx and tonsils (including adenoids):																																												
Streptococcic sore throat																								1																				1	1				1
Ludwig's angina																								1																				1	1				1
Diseases of the esophagus						1																																				1			1		1		
Diarrhea and enteritis (under 2 years of age)				4				1								6				28								1				1				2				1				44	44				6
Diarrhea and enteritis (2 years and over)						1		1										3		6																		1				5		7	12		2		1
Ankylostomiasis										1																																1			1		1		
Diseases due to other intestinal parasites:																																												
Ascariasis																1																												1	1				1
Appendicitis and typhlitis				1		1						1		2										1																		3		3	6		3		3
Hernia, intestinal obstruction:																																												
Hernia						1																																				1			1		1		
Intestinal obstruction											1					2				1										2		1			1	1						2	2	5	9		2	2	5
Other diseases of the intestines:																																												
Diseases of the anus and stercoral fistulae																1																												1	1				1
Other diseases of the intestines		1				1		1						1				1		1																						4		2	6		4		2
Acute yellow atrophy of the liver																1																												1	1				1
Cirrhosis of the liver:																																												
Returned as alcoholic		1									1																											1				2	1		3		2	1	
Not returned as alcoholic																		1		1				1																		1		2	3		1		1
Other diseases of the liver:																																												
Abscess of the liver, amebic																						1																				1			1		1		
Other diseases of the liver														1		1		1																						1		2		2	4		2		2
Peritonitis of unstated cause						1		1						1		1						1																		1		3		3	6		3		3
Non-Venereal Diseases of the Genitourinary System and Its Adnexa:																																												
Acute nephritis (including unspecified under 10 years of age)								1	1	1		1								8																5					1	1		15	17	1	1		10
Chronic nephritis (including unspecified over 10 years of age)						4		1	1	3		1		2				6		3						1				4		1		2		1		1			1	23		7	31	1	16		4
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included)		1												1		1		1																				1				4		1	5		4		1
Diseases of the bladder (except tumors)												1								1																								2	2				2
Diseases of the urethra, urinary abscess, etc.:																																												
Others								1						1																												1		1	2		1		1
Diseases of the prostate (except tumors)																				1										1												1		1	2		1		1
The Puerperal State:																																												
Accidents of pregnancy:																																												
Abortion												1																																1	1				1
Puerperal hemorrhage								1												1																								2	2				2
Other accidents of childbirth:																																												
Other surgical operations and instrumental delivery																				1																2				1				4	4				3
Others												1																																1	1				
Puerperal septicemia								2				1				2				4																3				1				13	13				12
Puerperal albuminuria or convulsions								1				1				1			1	1																1							1	5	6			1	5
Childbirth (without other explanation)																																								1				1	1				
Diseases of the Skin and of the Cellular Tissue:																																												
Gangrene								1														1																				1		1	2		1		1
Diseases of the Bones and of the Organs of Locomotion:																																												
Diseases of the bones (tuberculosis excepted)								1																																				1	1				1
Malformations:																																												
Congenital malformations (stillbirths excepted):																																												
Malformations of heart																				1																								1	1				1
Others												1																																1	1				1
Diseases of Early Infancy:																																												
Congenital debility, icterus and sclerema:																																												
Marasmus												2				2				1																2								7	7				6
Inanition																3				2								1				1												7	7				3
Others								1												8																2								11	11				3

CLASSIFICATION OF DEATHS BY DISEASE—*Concluded*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
Diseases of Early Infancy—Concluded:																																																	
Premature birth, or consequence of labor:																																																	
Premature birth																1				1																3				1				6	6				6
Injury at birth																1																								1				2	2				2
Other diseases peculiar to early infancy:																																																	
Umbilical hemorrhage																1				1																								2	2				1
Others																				1																								1	1				
Lack of care																1				4																				1				6	6				1
Old Age:																																																	
Old age														1				1		4																				1		2		5	7		2		
External Causes:																																																	
Suicide										1										2																				1		1		3	4				2
Snake bite																1														1												1		1	2		1		1
Other acute poisonings		1														2																										1		2	3		1		2
Burns and scalds								1				1																										1				1		2	3		1		2
Absorption of irrespirable or poisonous gas										1		1																														1		1	2				
Accidental drowning																		1												1								2		1		4		1	5				
Injury by firearms				1				1		5		1		2																4		1		2		6	1	29	1	13	1	42	1	23	67		14	1	15
Injury by cutting or piercing instruments										2		2																						1			2	18	1	6	2	21	1	8	32		8		5
Injury by falls										2						2														1						1		2				5		3	8		2		3
Traumatism by other crushing (vehicles, railways, landslides, etc.)	1	2								3		1		2										1		1				1				1		1		1		1	1	11		4	16	1	6		4
Homicide by firearms				1																		3		1						2		1										5		3	8		3		2
Homicide by cutting or piercing instruments		1																						1																		1		1	2		1		1
Homicide by other means																								1																				1	1				1
Fractures (cause not specified)						1		1				1						1		1																						2		3	5		2		2
Other external violence:																																																	
Other external violence														1		1																						1				2		1	3				1
Ill-Defined Diseases:																																																	
Ill-defined organic diseases														1																								4		3		5		3	8				
No disease; malingering												5																																5	5				
Totals	2	29	1	20	1	34	2	46	4	63	3	46		77	2	99	3	77	2	157		29	4	36		11		3		44		11	1	27	3	60	4	95	2	64	15	486	19	542	1,062	12	374	18	363

Note: This table includes all deaths. See Appendix of table on page 288.

RECORD OF REPATRIATIONS

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
EPIDEMIC, ENDEMIC OR INFECTIOUS DISEASES:																																													
Malaria fever or cachexia:																																													
Estivo-autumnal						1																																				1			1
Clinical		1																																								1			1
Amebiasis without dysentery																														1												1			1
Leprosy						4																																				4			4
Tuberculosis of the respiratory system:																																													
Acute pulmonary tuberculosis					1	17			1	31				8				2												1				44							2	103			105
Other forms of tuberculosis of respiratory organs		6								2																				1				2				13				24			24
Tuberculosis of the meninges or of the central nervous system																																		1								1			1
Tuberculosis of other organs and structure:																																													
Tuberculosis of the skin or subcutaneous cellular tissue																																		2								2			2
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):																																													
Tertiary						1																																				1			1
Period not specified																														1												1			1
Gonococcal infection, except that of the eye or adnexa						1																																				1			1
GENERAL DISEASES NOT INCLUDED ABOVE:																																													
Cancer or other malignant tumors of the female genital organs:																																													
Cancer of the uterus						1																																				1			1
Others																		1																								1			1
Cancer or other malignant tumors of other or unspecified organs:																																													
Others						1				1								1																								3			3
Chronic rheumatism or gout:																																													
Chronic rheumatism														1																												1			1
Diabetes																																						1				1			1
DISEASES OF THE NERVOUS SYSTEM AND ORGANS OF SPECIAL SENSE:																																													
Meningitis:																																													
Non-epidemic cerebro-spinal meningitis						1																																				1			1
General paralysis (of the insane)																		1																								1			1
Other forms of mental alienation		2																																								2			2
Diseases of the organs of vision and adnexa (except gonococcal infection):																																													
Diseases of the eye (except tumor)																														2												2			2
Other diseases of the eye or its adnexa										1				1																1												3			3
DISEASES OF THE CIRCULATORY SYSTEM:																																													
Other diseases of the heart:																																													
Chronic myocarditis														2																												2			2
Aneurism																																						1				1			1
Atheroma and other diseases of the arteries						1																																				1			1
DISEASES OF THE RESPIRATORY SYSTEM:																																													
Pneumonia:																																													
Lobar						1																																				1			1
Pleurisy:																																													
Empyema of thoracic cavity														1																												1			1
Asthma		1				4																																				5			5
Emphysema of the lung						1																																				1			1

RECORD OF REPATRIATIONS—*Concluded*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
Diseases of the Digestive System:																																													
Other diseases of the stomach (cancer excepted):																																													
Indigestion																		1																								1			1
Cirrhosis of the liver:																																													
Not returned as alcoholic						2																																				2			2
Non-Venereal Diseases of the Genito-urinary System and Its Adnexa:																																													
Chronic nephritis (including unspecified under 10 years of age)						1												1																								2			2
Diseases of the Skin and of the Cellular Tissue:																																													
Other diseases of the skin and its adnexa:																																													
Ulcer of the skin						1																																				1			1
Other diseases of the skin and adnexa														1																												1			1
Old Age:																																													
Old age														1																												1			1
Totals		10			1	38			1	35				15				7												7				49				15			2	176			178

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Total*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
Epidemic, Endemic or Infectious Diseases:																																													
Typhoid fever (abdominal typhoid and paratyphoid):																																													
Typhoid fever					1	19	3	51		3				16		12	1	20	2	41		1	3	1				1		15		4				1	2	74	8	111	195		20	3	15
Paratyphoid fevers		2		1		4		4						12		4				2																		18		11	29		2		1
Typhus fever (exanthematous)																																													
Relapsing fever (spirillum obermeieri)																																													
Melitococcosis (Malta fever)																																													
Malarial fever or cachexia:																																													
Estivo-autumnal	7	57	3	22	14	143		37	2	523	7	68	5	285	5	171	16	171	5	125	5	150	12	162	3	67		22	11	303	8	141	26	280	3	105	89	1979	43	853	2964	1	7	4	20
Tertian	20	69	1	34	4	56		19	2	175	3	14	1	1		1		5	1	3	2	138	3	127		5		1	7	51	1	32	10	49	3	40	46	550*	12	271	879*		1	1	3
Quartan						1		1		4		2		1				1		1		13	2	8						6	1	4		1				27	3	16	46				
Mixed	1	1		2		6		1		2								5		3	1	41	4	48					1	7		2	3	11		6	6	73	4	62	145				
Clinical	1	10		2	9	58		10	14	398	2	70	1	3		6				1		1		1		1		1		28		4	3	17	3	17	30*	520*	5	112	667*		1		3
Cachexia		1								41		9					1	19		8				1		3				4						1	1	69*		19	89*		2		
Hemoglobinuric fever	1	10		2		1		1		14		2	2	17		9					1	13		7		3				6			3	31		5	7	95		26	128	1	20		10

Smallpox						2																								2				10		7		14		7	21				
Measles		1				4		1								6				1	1					4		1						2		3	1	11		12	24				
Scarlet fever																																													
Whooping cough				1								3												1				2				1								8	8				
Diphtheria				1	1	2	1	4												6																	1	2	1	11	15				
Influenza (complications):																																													
Pneumonia						2			5	57	2	6		5		2					18	89	11	38		4		1	9	216	4	27		18		3	32	392*	17	77	518*		8		2
Bronchitis		3		1	10	136		9		87	2	14		4		4	2	2					1	1		1		3		11		37	5	39	1	10	22*	283	4	79	388*				
Heart disease																										1												1			1		1		
Nephritis																																													
Meningitis										1																						1						1		1	2				1
Gastro-intestinal		1																										1									1*	2*		1	4*				
Puerperal																																													
Others										2			13	192	7	71	3	46		10					4	47		8				1	15	71	2	31	38*	359*	9	121	527*				
Miliary fever																																													
Mumps										4								1				6		1		1				15		2		42		3		69		6	75				
Asiatic cholera																																													
Cholera nostras (Choleriform enteritis)																																													
Dysentery:																																													
Amebic	1	7		1	2	23		4	2	119	3	37		120	2	23		2		2	1	14	7	20		1			1	27	5	32		21		4	7	334	17	123	481		6		6
Bacillary						1												1			1		1							2		4					1	4	1	4	10		2		
Unspecified or due to other causes		7				9				2		1		3																23		3	1	2		2	1	46		6	53				
Amebiasis without dysentery					1	83		16								2										2											1	85		18	104				
Plague:																																													
Bubonic																																													
Pneumonic																																													
Septicemic																																													
Unspecified																																													
Yellow fever																																													
Ictero-hemorrhagica spirochetosis						8		4																														8		4	12		1		2
Leprosy						6								1		1																						7		1	8				1
Erysipelas						5			2	6		3		1		1		2		1		4	1	3		2				4		3				3	2	24	1	14	41				1
Acute poliomyelitis																																													
Encephalitis lethargica																																													
Epidemic cerebrospinal meningitis																														1								1			1				
Other epidemic diseases:																																													
Alastrim or Kaffir milk-pox																																													
Varicella						8		5		5		1						2								4				7		1				1		26		8	34				
Filariasis																												1		2		1						2		2	4				
Dengue						2		2																														2		2	4				
Yaws						2												30																				32			32				
Others																																		1				1			1				
Purulent or septicemic infection		2				1		3		1	1			2			1	3		2						2				1				3	1	4	1	15	2	9	27		12		3
Glanders and farcy																																													
Malignant pustule (anthrax)																																													
Rabies																																													
Tetanus				1		1				1		1				1		1		1						1		1				2		1				5		7	12		2		6
Mycoses																		2																				2			2		1		
Tuberculosis of the respiratory system:																																													
Acute pulmonary tuberculosis					1	27	2	5		32		2	1	31		32		33		8		15	1	10		7		1	1	44		16		7		5	3	197*	3	79	282*		19		10
Other forms of tuberculosis of the respiratory organs	1	22		3						6		4						1								1		1		2		1	1	36		4	2	68		13	83		8		1
Tuberculosis of the meninges or of the central nervous system																		1												1								2			2		2		
Tuberculosis of the intestines or peritoneum																			2																				2		2			1	
Tuberculosis of the vertebral column														2		2																						2		2	4				
Tuberculosis of the joints																		1																				1			1				

NOTE.—This table gives only *cases* treated in our Hospitals and does not show the *number of treatments*.

* Including Jamaica Division—See Explanatory Notes on page 320.

† Under "No disease; malingering" are included (a) infants born in the Hospital, nursling babies, well mothers who entered the Hospital with ill babies, and babies who were admitted with ill mothers; and (b) patients who were found to be without physical ailment of any kind, or who were malingering.

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS—*Continued*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Totals*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
Epidemic, Endemic or Infectious Diseases—*Concluded:*																																													
Tuberculosis of other organs and structure:																																													
Tuberculosis of the skin and subcutaneous cellular tissue	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	2	...	2	4	...	...	...	...
Tuberculosis of the bones (except vertebral column)	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2	2	...	...	...	...
Tuberculosis of the lymphatic system (except the mesenteric and retroperitoneal glands)	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	4	...	...	...	...
Tuberculosis of the genito-urinary system	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2	...	1	3	...	2	...	...
Tuberculosis of other organs	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	3	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	3	1	2	6	...	...	...	...
Disseminated tuberculosis:																																													
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary)	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	4	...	1	5	...	2	...	1
Chronic	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	2	...	...	...	...
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):																																													
Primary	...	1	...	...	...	2	...	...	...	...	...	1	...	1	4	3	...	...	...	2	1	8	1	3	1	...	...	...	1	8	...	5	...	5	...	1	3	25	5	15	48	...	1	...	...
Secondary	...	4	...	...	1	14	...	1	...	14	...	6	...	2	...	2	...	8	...	1	...	3	2	...	...	...	...	...	...	15	1	1	...	2	...	1	1	62	3	12	78	...	...	...	...
Tertiary	3	54	1	9	...	86	1	14	1	16	...	5	1	30	1	14	...	44	1	9	...	13	...	4	...	3	...	...	...	30	2	45	...	8	...	19	5	284	6	119	414	1	2	...	1
Hereditary	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	3	...	3	6	...	...	...	1
Period not specified	...	...	...	...	...	...	...	...	...	3	...	1	...	...	...	1	...	2	...	1	...	4	...	...	...	13	...	...	...	1	...	...	...	5	...	...	...	28	...	3	31	...	5	...	...
Soft chancre	...	3	...	...	...	6	1	1	...	9	...	1	...	8	1	2	1	3	...	1	...	8	1	4	...	3	...	...	...	66	...	3	...	16	1	...	1	122	4	12	139	...	...	...	...
Gonococcal infection, except that of the eye or adnexa	3	26	...	2	1	55	2	5	1	39	...	14	...	47	6	16	2	26	...	5	3	39	11	24	...	11	1	...	...	42	2	18	1	41	5	6	11	326	27	90	454	...	1	...	...
Gonococcal ophthalmia	...	...	...	2	...	...	...	1	...	1	...	1	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	3	...	6	9	...	...	...	...
General Diseases Not Included Above:																																													
Cancer or other malignant tumors of the buccal cavity:																																													
Cancer of the lip	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cancer of the tongue	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cancer of the mouth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cancer of the jaw	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Others	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cancer or other malignant tumors of the stomach and liver:																																													
Cancer of the pharynx	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cancer of the esophagus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	2	...	...	...	...
Cancer of the stomach	...	...	...	2	...	2	...	2	1	...	...	...	...	4	...	...	...	3	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	10	...	4	15	...	6	...	...
Cancer of the liver and gall bladder	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	2	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	3	5	1	1	...	1

Cancer or other malignant tumors of the peritoneum, intestines and rectum:																																													
Cancer of the mesentery and peritoneum																1																								1	1				1
Cancer of the intestines (except rectum)										1																												1			1		1		
Cancer of the rectum and anus								1								1										1												1		2	3				
Others																										1												1			1		1		
Cancer or other malignant tumors of the female genital organs:																																													
Cancer of the ovary and fallopian tubes																1																1								2	2				
Cancer of the uterus						2		3							1					1												2				4		2	1	10	13			1	1
Cancer of the vagina and vulva																				1																				1	1				
Others																2		1																				1		2	3				1
Cancer or other malignant tumors of the breast						1		1								1				1												1						1		4	5				1
Cancer or other malignant tumors of the skin																		2														1				2		2		3	5				
Cancer or other malignant tumors of other or unspecified organs:																																													
Cancer of the larynx																																													
Cancer of the lung and pleura																1		1														1						1		2	3		1		1
Cancer of the pancreas																								1																1	1				1
Cancer of the kidneys and suprarenals																																													
Cancer of the prostate														1																								1			1		1		
Cancer of the bladder																																													
Cancer of the brain																																		1				1			1		1		
Cancer of the bones (except jaw)																																1								1	1				
Cancer of the testes																																													
Others						3				1								3								1										1		8		1	9				
Benign tumors and tumors not returned as malignant (except benign or non-specified tumors of the ovary and uterus):																																													
Tumor of brain																				1																				1	1				
Tumor of thorax																																													
Tumor of abdomen																																													
Tumor of bladder														1																								1			1				
Tumor of prostate																		1						1														1		1	2				
Tumor of other location						10		4		4				3	1		1	7	2	6						3				1		5		4		1	1	32	3	16	52				1
Acute febrile articular rheumatism	1				1	22		2		3						1		6		1									1			5		1		4	3	32	1*	13	49*				
Chronic rheumatism or gout:																																													
Chronic rheumatism	1	3		1		5			2	12		2		3			3	19		1		12	2	4		13				3		2	1	1	1	2	7	71	3	12	93				
Chronic gout																																													
Scurvy																																													
Pellagra																																													
Beriberi						3		1										3												1				7		1		14		2	16				
Rickets																																													
Diabetes				1			1	1				1		1		3		2		3												1		1		1		4	1	11	16		1		2
Anemia, chlorosis:																																													
Pernicious anemia					1					1				2				4	1	11		7	4	9					1		1			1		1	2	15	6	21	44		1	1	1
Other anemias and chlorosis		1		1		13		1					1	25		7	1	3		3		1		6		1				11	2	12		14		2	2	69	2	32	105				3
Diseases of the pituitary gland										1										1																		1		1	2				
Diseases of the thyroid gland:																																													
Exophthalmic goiter																		1													1							1	1		2				
Other diseases of the thyroid gland												1				2		2		2																		2		5	7				
Diseases of the parathyroid glands																																		1				1			1				

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS—*Continued*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Total*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
General Diseases Not Included Above—*Concluded:*																																													
Diseases of the thymus																																													
Addison's disease (diseases of the adrenals)																																													
Disease of the spleen						26				1				4		5																		72		4		103		9	112				
Leukemia and Hodgkin's disease:																																													
Leukemia		1						1																								1						1		2	3		1		1
Hodgkin's disease																		1												1								2			2		1		
Alcoholism (acute or chronic)			1			1				4	2			3	1	2		2	1			3	1	2					1			1		4	2	3	1	17	8	8	34				
Chronic poisoning by mineral substances								1																																1	1				
Chronic poisoning by organic substances																																													
Other general diseases:																																													
Acidosis							2	2				1												1															2	4	6				
Amyloid degenerations																																													
Autointoxications				1		2		3										2																				4		4	8				3
Hemophilia										1										1														1		1		2		2	4				1
Purpura hemorrhagica					1	1		1																													1	1		1	3				
Others													1			2		1												1		1					1	2		3	6				1
Diseases of the Nervous System and of the Organs of Special Sense:																																													
Encephalitis										1						1		1												1								3		1	4		3		1
Meningitis:																																													
Simple						1				3				2		5		1				2		1										1		1		10		7	17		6		3
Non-epidemic cerebrospinal meningitis						1																								1		2		4		2		6		4	10		5		3
Progressive locomotor ataxia (tabes dorsalis)						2										1		1																				3		1	4				
Other diseases of the spinal cord:																																													
Bulbar paralysis (Duchenne's disease)																																													
Paralysis agitans (Parkinson's disease)																																													
Acute ascending spinal paralysis (Landry's disease)												1																												1	1				1
Myelitis																		1		1																1		1		2	3				1
Others										1		1							1											1	1							2	2	1	5				
Cerebral hemorrhage, apoplexy:																																													
Cerebral hemorrhage						4								6		2			1			2		2		1				1		1				1		14	2*	6	22*		7		4
Cerebral thrombosis and embolism								1				1														1												1		2	3				1
Paralysis (without specified cause):																																													
Hemiplegia	1							1						4		6				1						1			1					1			2	6		8	16		1		
Other forms of paralysis						1								1		1		2						1						1						2		5		4	9				
General paralysis (of the insane)																		2																				2			2		1		

Other forms of mental alienation	..	3	..	..	..	1	1	..	..	2	..	..	..	2	..	3	..	3	..	2	..	1	..	..	..	1	..	1	..	..	1	..	2	..	..	..	2	13	2	6	23	..	..	..	..
Epilepsy	..	..	..	1	..	7	..	..	..	8	..	1	..	1	..	3	1	1	..	..	..	..	..	..	..	..	..	1	..	2	..	1	..	6	..	3	1	25	..	10	36	..	..	..	..
Convulsions (non-puerperal) (5 years and over)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..
Infantile convulsions (under 5 years of age)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	1	..	..	..	5	5	..	..	..	2
Chorea:																																													
Chorea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..
Hysteria and neuralgia	..	1	..	2	..	8	..	5	..	5	..	9	..	5	..	5	..	6	2	11	..	2	..	1	..	1	..	1	1	13	..	9	..	1	..	1	1	42	2	44	89	..	..	..	..
Neuritis	1	1	..	..	..	13	..	2	..	1	..	..	..	2	..	1	1	6	..	5	1	1	..	..	..	..	..	..	..	3	..	3	..	..	..	1	3	27	..	12	42	..	..	..	..
Softening of the brain	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	..	..	..	1
Other diseases of the nervous system	..	2	..	..	..	7	..	4	..	5	..	..	..	2	1	1	..	13	..	5	..	1	..	..	..	1	..	..	1	1	1	5	..	11	..	3	1	44*	2	18	65*	..	1	..	..
Diseases of the organs of vision and adnexa (except gonococcal infection):																																													
Diseases of the eye (except tumor)	1	1	..	1	..	..	..	..	..	9	..	..	..	..	..	..	2	7	..	4	..	..	..	..	..	1	..	..	1	100	..	3	1	4	..	3	5	12-	..	11	138	..	..	..	..
Follicular conjunctivitis	..	3	..	..	..	6	..	1	..	..	..	1	..	10	..	2	..	4	..	2	1	22	1	9	2	1	..	1	..	..	..	..	..	4	..	..	3	50	1	16	70	..	..	..	..
Trachoma	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	1	..	6	..	..	..	..
Tumors of the eye	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Other diseases of the eye or its adnexa	..	1	..	..	1	15	1	1	..	14	..	5	..	6	..	7	1	13	..	1	..	9	..	3	..	4	..	..	..	4	..	17	2	32	..	10	4	98	1	44	147	..	..	..	..
Diseases of the organs of hearing and the mastoid process:																																													
Diseases of the ear	2	6	1	..	2	14	2	4	1	4	..	..	..	9	2	..	1	..	1	2	2	5	1	4	..	2	..	2	..	17	..	3	3	13	..	6	11	70	7	21	109	..	..	..	..
Diseases of the mastoid process	..	..	..	..	..	..	..	2	..	1	..	1	..	2	..	1	..	..	..	..	1	1	..	..	..	..	..	..	..	2	..	3	..	1	..	..	1	7	..	7	15	..	..	..	1
Diseases of the Circulatory System:																																													
Pericarditis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	4	..	..	..	1	..	..	..	..	..	..	..	1	..	1	..	..	..	1	..	..	..	2	1	6	9	..	2	..	4
Acute endocarditis and myocarditis:																																													
Acute endocarditis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	..	..	..	..	..	..	..	1	..	1	..	4	..	2	1	6	9	..	1	..	2
Acute myocarditis	..	1	..	..	..	1	..	3	..	..	..	1	..	..	..	2	..	1	..	..	..	..	..	..	..	..	..	..	1	2	..	1	..	1	..	3	1	7*	..	10	18*	1	2	..	4
Angina pectoris	..	..	..	..	..	1	..	..	1	1	..	1	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	4	..	2	7	..	..	..	..
Other diseases of the heart:																																													
Chronic endocarditis	..	1	..	..	..	1	..	2	..	..	..	..	..	1	..	3	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	4	..	4	..	10	14	..	3	..	2
Chronic myocarditis	..	3	1	1	..	3	..	1	..	..	..	1	..	26	1	16	1	4	..	..	..	..	..	..	..	3	..	..	..	2	..	4	2	5	..	3	3	46	2	26	77	..	15	1	10
Other chronic diseases of the heart	..	1	..	3	..	12	1	6	..	..	..	..	..	1	..	4	..	9	..	9	1	..	5	2	1	4	1	..	..	..	..	1	..	3	..	1	2	30	7	26	65	..	14	..	5
Aneurism	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	4	..	1	..	..	..	..	..	5	..	2	..	..	..	..	..	..	..	..	..	10	..	4	14	..	4	..	2
Atheroma and other diseases of the arteries	..	2	..	..	..	17	..	4	..	..	..	1	..	11	..	12	..	5	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	35	1	19	55	..	1	..	1
Embolism and thrombosis (except cerebral)	..	1	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	1	3	1	1	..	..
Diseases of the veins (varices, hemorrhoides, phlebitis, etc.)	..	..	1	4	2	28	1	..	..	2	..	..	..	1	2	1	3	18	1	7	2	8	1	6	..	1	..	..	3	5	2	7	..	..	..	..	10	64*	8	25	107*	..	..	..	..
Diseases of the lymphatic system (lymphangitis, etc.)	..	6	..	4	..	33	1	16	..	22	..	1	..	21	3	9	1	17	..	3	..	1	1	..	..	11	..	..	1	17	2	3	..	10	1	4	2	138	8	40	188	..	1	..	..
Hemorrhage without determined cause; other diseases of the circulatory system	..	..	..	..	..	2	..	1	..	1	..	..	..	2	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	1	..	1	..	..	..	8*	..	3	11	..	..	..	..
Diseases of the Respiratory System:																																													
Diseases of the nasal fossae and their adnexa:																																													
Diseases of the nasal fossae	3	10	..	3	1	2	..	2	..	2	..	..	..	2	..	1	..	3	..	..	..	..	2	..	..	..	..	..	..	5	1	1	1	14	..	4	5	38	3	11	57	..	..	..	..
Others	..	..	..	..	..	2	..	4	..	2	..	..	..	3	..	2	..	2	..	..	..	..	..	..	..	..	..	1	..	2	..	..	..	3	..	1	..	14	..	8	22	..	..	..	..
Diseases of the larynx (except tuberculosis and cancer)	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	4	6	..	..	..	..
Bronchitis:																																													
Acute	3	31	3	2	1	25	2	5	..	3	..	3	..	43	1	20	6	23	1	24	3	41	5	22	..	2	..	1	2	30	3	23	8	82	..	39	23	280	15	139	457	..	..	..	3
Chronic	..	6	..	2	..	9	..	1	..	8	..	3	..	2	..	2	1	5	..	3	..	..	..	..	..	..	..	..	..	2	..	4	2	10	..	1	3	42	..	16	61	..	..	..	1

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS—*Continued*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Total*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
Diseases of the Respiratory System—*Concluded*:																																													
Not otherwise defined (under 5 years of age)																14																								14	14				
Not otherwise defined (5 years and over)														32	1	18																		1				33	1	18	52				
Bronchopneumonia (including capillary bronchitis):																																													
Bronchopneumonia	1	6		6		1	1	14		2		3		2		11		5	2	9				1		4		3	1	8		15		10		15	2	38	3	77	120	1	9		36
Capillary bronchitis								3		1		1																				3				1		1		8	9				
Pneumonia:																																													
Lobar		11		1		13		3	1	8		10		21		14		7		2		41	1	18		3		2		29	1	12		31	1	15	1	164	3	77	245	1	59	1	28
Not otherwise specified						1				2		3		4		2								1						5								12		6	18				1
Pleurisy:																																													
Pleurisy		5		1		6	1	5	2	7			1	14	1	2		9		3						3	1	2		26		3	1	8	1	5	4	78	4	21	107		1		
Empyema of thoracic cavity		1				1		1		1				2						1										4				1				10		2	12		1		1
Congestion or parenchymatous hemorrhage of the lung																																													
Gangrene of the lung																	2			1										1							2	1		1	4	1			
Asthma		4	1	1	1	19		5		3		4	1	15		5	1	14		4	1	1		3				1		6		1		5		4	4	67	1	28	100		1		
Emphysema of the lung						4								1																1		2						6		2	8				
Other diseases of the respiratory system (tuberculosis excepted):																																													
Chronic interstitial pneumonia (including occupational diseases of the lungs)																																													
Diseases of the mediastinum																		1												2	1	1						3	1	1	5				
Others		1		1		1		1		1				1		1		1		2														2				7		5	12		3		
Diseases of the Digestive System:																																													
Diseases of the mouth and adnexa:																																													
Diseases of the teeth and gums	1	5		1		1			2	8		4		11		3	1	20		4	2	13		11		2				12		3	1	17		10	9*	89		36	134*				
Other diseases of the buccal cavity and adnexa						1		2								3		3	3	6		1										2		1		2		6	3	15	24				
Diseases of the pharynx and tonsils (including adenoids):																																													
Streptococcic sore throat											1	1												1					1	1		1					1	1	1	3	6				1
Ludwig's angina								1																1																2	2				1
Tonsillitis	2	3		8		8		8	1	5		1	2	14	3	11	7	23	8	84	6	6	4	14			1		1	2		17	1	7		5	20	68	16	148	252				
Adenoids											2	1																				1							2	2	4				
Others		1			1	11		1						2		1		1	1	8				2		3		3				2		7		1	1	25	1	18	45				
Diseases of the esophagus						1				1																						1						2		1	3		1		
Ulcer of the stomach and duodenum:																																													
Ulcer of the stomach									1					1	1		2	7		2		4	1	2													3	12	2	4	21				
Ulcer of the duodenum									1	2			1					2																			2	4			6				
Other diseases of the stomach (cancer excepted):																																													
Indigestion	1	4		3	1	10		1		8		3	1	5	2	2	7	49	4	28	16	52	14	61						21	3	19	3	20	1	17	29	169	24	134	356				

Gastritis	..	4	1	1	1	4	..	5	..	8	..	1	..	..	..	..	1	10	..	2	..	..	..	..	..	7	..	1	..	1	..	..	..	7	..	2	2	41	1	12	56	..	..	..	..
Stricture or stenosis of pylorus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Others	1	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	8	1	9	..	..	..	..	..	..	..	..	..	1	..	2	1	2	..	1	3	18	1	12	34	..	..	..	..
Diarrhea and enteritis (under 2 years of age)	..	..	..	..	..	..	..	5	..	..	..	5	..	..	..	14	..	..	..	11	..	..	..	1	..	..	..	1	..	..	..	8	..	..	..	5	..	..	..	50	50	..	..	..	6
Diarrhea and enteritis (2 years and over)	4	3	1	..	7	19	4	8	1	39	..	7	2	16	..	4	4	8	2	11	1	..	1	5	..	6	1	1	1	13	1	5	2	13	1	3	22	118*	11	44	195*	..	2	..	1
Ankylostomiasis	..	49	..	10	1	65	..	3	2	33	..	6	..	14	..	4	..	6	..	4	..	72	1	42	..	2	..	1	..	16	..	17	1	8	..	20	4	265	1	107	377	..	1	..	..
Diseases due to other intestinal parasites:																																													
Cestodes (hydatids of the liver excepted)	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	2	3	..	..	..	..
Trematodes	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	2	7	..	..	..	..	..	..	2	9	11	..	..	..	..
Filariasis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	1	..	..	..	..
Ascariasis	..	1	..	1	..	2	..	1	..	21	..	2	..	4	..	4	..	..	..	1	1	34	..	13	..	..	..	..	..	5	3	32	..	2	2	8	1	69	5	62	137	..	..	..	1
Trichocephalus	..	1	..	..	..	..	..	..	..	..	..	1	..	1	..	4	..	1	..	..	..	3	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	11	17	..	..	..	..
Nematodes not specified	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Parasites not specified	..	2	..	..	..	9	..	1	..	3	..	1	..	2	..	1	2	2	..	9	..	1	..	..	..	..	..	..	..	..	..	2	..	1	1	13	2	20	1	27	50	..	..	..	..
Appendicitis and typhlitis	1	3	..	6	1	9	2	8	6	19	..	3	3	2	..	6	2	14	7	56	4	9	6	9	..	2	..	3	1	3	5	3	..	3	..	1	18	64	20	95	197	..	3	..	3
Hernia, intestinal obstruction:																																													
Hernia	..	7	..	..	2	60	..	7	1	6	..	4	..	12	1	13	2	41	2	15	2	6	4	4	..	5	..	1	..	12	..	1	2	10	..	3	9	160*	7	48	224*	..	1	..	..
Intestinal obstruction	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	2	..	..	..	2	..	..	..	..	..	3	..	1	..	..	1	1	..	..	..	..	..	4	2	6	12	..	2	2	5
Other diseases of the intestines:																																													
Diseases of the anus and stercoral fistulae	..	..	..	..	..	4	..	3	..	1	..	1	1	4	..	6	1	..	..	2	..	..	..	..	..	..	..	..	1	4	1	7	1	2	..	1	4	15	1	20	40	..	..	..	1
Other diseases of the intestines	1	8	..	..	..	6	..	4	..	1	..	1	1	8	1	9	..	4	..	6	..	..	..	..	..	7	..	1	..	3	..	1	..	2	..	12	3*	39	1	34	77*	..	4	..	2
Acute yellow atrophy of the liver	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	1
Hydatid tumor of the liver	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cirrhosis of the liver:																																													
Returned as alcoholic	..	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	2	..	1	..	..	1	4	2	2	9	..	2	1	..
Not returned as alcoholic	..	1	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	1	..	..	..	..	..	2	..	..	..	3	..	..	..	12	..	1	13	..	1	..	1
Biliary calculi	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	1	..	..	..	2	..	..	..	..	..	..	..	1	1	..	..	5	..	..	..	..	1	1	1	9	12	..	..	..	..
Other diseases of the liver:																																													
Abscess of the liver, amebic	..	1	..	..	..	2	..	1	..	4	..	..	..	..	..	..	..	1	..	..	..	1	1	..	..	..	..	..	..	1	..	2	..	..	..	..	..	10	1	3	14	..	1	..	..
Other diseases of the liver	..	3	..	1	1	16	2	9	..	5	..	..	2	15	1	13	..	3	2	7	..	..	..	2	..	2	..	..	..	19	..	6	1	13	2	9	4	76	7	47	134	..	2	..	2
Diseases of the pancreas (except cancer)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	..	..	..	..
Peritonitis of unstated cause	..	..	..	..	..	1	..	2	..	..	..	..	..	1	..	1	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	3	..	5	8	..	3	..	3
Other diseases of the digestive system (cancer and tuberculosis excepted)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1	2	..	1	..	3	1	3	..	..	..	..	1	6	1	4	12	..	..	..	..
Non-Venereal Diseases of the Genitourinary System and Its Adnexa:																																													
Acute nephritis (including unspecified under 10 years of age)	..	2	..	..	1	21	..	5	1	5	..	3	..	7	..	9	1	3	1	12	..	..	..	2	..	..	..	1	..	8	..	6	..	4	1	1	3	50	2	39	94	1	1	..	10
Chronic nephritis (including unspecified over 10 years of age)	..	..	..	..	..	10	1	4	2	19	..	5	1	9	..	7	1	14	..	7	3	8	1	7	..	3	..	3	1	6	..	3	..	9	..	1	8	78	2	37	125	1	16	..	4
Chyluria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included)	1	5	2	..	1	17	..	16	1	2	..	5	..	5	..	7	4	6	3	20	..	..	..	..	..	1	..	..	..	4	..	4	..	2	2	..	7	42	7	52	108	..	4	..	1
Calculi of the urinary passages	..	..	..	..	..	..	2	1	..	4	..	1	1	..	1	..	1	2	..	2	..	..	..	..	..	..	..	..	..	3	..	3	..	1	..	..	2	10	3	7	22	..	..	..	..
Diseases of the bladder (except tumors)	..	1	..	2	2	13	1	8	..	1	..	3	2	10	1	10	1	8	2	12	..	1	..	1	..	2	..	2	..	..	1	2	..	3	..	5	5	39	5	45	94	..	..	..	2
Diseases of the urethra, urinary abscess, etc.:																																													
Stricture of the urethra	..	3	..	..	..	10	..	4	1	5	..	1	..	11	..	4	2	22	..	1	..	..	..	..	..	3	..	..	..	..	..	1	..	2	..	3	3	56	..	14	73	..	..	..	..
Others	..	1	..	1	..	1	..	1	..	..	..	..	..	5	..	..	..	1	..	..	..	..	..	..	..	4	..	..	..	..	..	1	..	..	..	..	..	12	..	3	15	..	1	..	1
Diseases of the prostate (except tumors)	..	2	..	..	..	10	..	7	..	1	..	1	..	3	..	5	..	4	..	6	..	..	..	..	..	3	..	..	1	2	..	2	..	..	..	..	1	25	..	21	47	..	1	..	1
Non-venereal diseases of the male genital organs	2	5	1	..	1	16	..	6	..	5	..	1	..	19	1	8	3	30	1	9	2	5	1	1	..	2	..	1	..	7	..	3	1	12	3	3	9	102*	7	32	150*	..	..	..	..

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS—*Continued*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Total*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
Non-Venereal Diseases of the Genitourinary System and its Adnexa—*Concluded:*																																													
Cysts and other benign tumors of the ovary				2				5				1				4				6			2													1			2	19	21				
Salpingitis or pelvic abscess				2		3	1	23		1		13				7				11		1	1	4		2		4			1	18		2		13		9	3	95	107				
Benign tumors of the uterus						1		6				2		1		6		2		6										1		8						5		28	33				
Non-puerperal uterine hemorrhage						1		2				3								3				1						1		1		1		9		3		19	22				
Metritis								2				2				1				1												25		1		6		1		37	38				
Other diseases of the female genital organs			2	10		3	3	29				4		6		15	1	1	1	37		1	3	6		9	1	14			4	25			2	14	1	20	16	154	191				
Non-puerperal diseases of the breast (cancer excepted)						1																				1		2								1		2		3	5				
The Puerperal State:																																													
Accidents of pregnancy:																																													
Abortion			2	5		2	2	16			1	22				17			2	25		1		8				5		1	3	13				18		4	10	129	143				1
Ectopic gestation				1				2				1							1	18												2				4			1	28	29				
Other accidents of pregnancy				6				4		1	2	9		4	1	25				7		2	5	7				1			3	7				7		7	11	73	91				
Puerperal hemorrhage								4												1															1	1			1	6	7				2
Other accidents of childbirth:																																													
Caesarean section												2				2				1																				5	5				
Other surgical operations and instrumental delivery			1				1					2				3				19			1	1								5				2			3	32	35				3
Others				1				3				1				3		1		7			5	14				1				1				1		1	5	32	38				
Phlegmasia alba dolens, puerperal embolism, etc.												1				1				1												1								4	4				
Puerperal septicemia								4		1		2				3			1	10												3		2		3		3	1	25	29				12
Puerperal albuminuria or convulsions								2				1				1			1	1												2							1	7	8			1	5
Childbirth (without other explanation)			4	18		2	7	40			1	44		1	5	56		2	12	74						1		19			11	79		1	2	71		7	42	401	450				
Puerperal diseases of the breast												5																			1	6				1			1	12	13				
Diseases of the Skin and of the Cellular Tissue:																																													
Gangrene						2		1						1		1		1				1						1		1								6		3	9		1		1
Boil, carbuncle, furuncle		2			1	23		4		37		1	1	8	1	2	7	18		9		8		4	1	4		1	1	22	2	8	2	11		4	15*	133	4*	33	185*				
Phlegmon, acute abscess		14	1	1		73	1	13	1	69	2	6		47	3	26	6	82	3	31	5	62	3	40	1	5		4	4	81		19	3	93		26	20	526	13	166	725				
Tinea and alopecia																																													
Pruritis																																													
Other diseases of the skin and its adnexa:																																													
Trichophytosis		1										1								1		3	1	2						11		5		5		1		20	1	10	31				
Scabies										1								4			1									2		4		2		2	1	9		6	16				
Chiggers (pulex penetrans)																		1																				1			1				
Red bug																						1																1			1				
Pemphigus contagiosus																														1								1			1				
Mycetoma																																													
Ground itch										5																				3				4		1		12		1	13				
Filaria medinensis																																													
Elephantiasis																		1																				1			1				
Myiosis of skin														2	1																					1		2	1	1	4				

Dhobie itch		1				4	1	1		4		1		1																				5		2		15	1	4	20				
Prickly heat						1				1																						1				1		2		2	4				
Ulcer of the skin		11	1		1	54		2		25	1	3		80	2	23	2	17		4	2	51	3	18		9				19		2	2	64		13	7	330	7	65	409				
Ainhum										1																												1			1				
Ulcerating granuloma of the pudenda																																		2				2			2				
Impetigo contagiosa													1	7		6		6		6								1			1	1		11		3	1	24	1	17	43				
Urticaria				1	1	1						1				1				1		1											1	6			2	8		4	14				
Other diseases of the skin and adnexa	1	12			3	33		2		4			1	50	1	19		35	1	8	1	19	1	10		19	2	1	1	23		9		8	1	3	7	203	6	52	268				
Diseases of the Bones and of the Organs of Locomotion:																																													
Diseases of the bones (tuberculosis excepted)		2		2		4		5		2		1		1	1	1		4		2										1	1	1				5		14	2	17	33				1
Diseases of the joints (tuberculosis and rheumatism excepted)	1	4			1	13		5		9	1	2	2	15		4	1	6		4		1				10				9	1	3	1	2	2		6	69	4	18	97				
Other diseases of the bones or organs of locomotion	2	3		1		39		3		1			1	18		3		5				2		1						61		2	1	26		1	4	155		11	170				
Malformations:																																													
Congenital malformations (stillbirths excepted):																																													
Hydrocephalus																																1								1	1				
Malformations of heart																				1																				1	1				1
Others								1				1				1								5												3				11	11				1
Diseases of Early Infancy:																																													
Congenital debility, icterus and sclerema:																																													
Marasmus												2				3				1												3								9	9				6
Inanition								2								22				2				1																27	27				3
Icterus																																													
Sclerema																																													
Others								1																								2								3	3				3
Premature birth, or consequence of labor:																																													
Premature birth				1				2				1				1				3												3				1				12	12				6
Injury at birth								2								1																				1				4	4				2
Other diseases peculiar to early infancy:																																													
Asphyxia neonatorum																																													
Atelectasis																																													
Umbilical infection																																													
Umbilical hemorrhage																1																								1	1				1
Others								1												1																				2	2				
Lack of care												2				1		1		1																		1		4	5				1
Old Age:																																													
Old Age										2				2		2		4																				8		2	10		2		
External Causes:																																													
Suicide																				3																				3	3				2
Poisoning by food																	2	5		3																	2	5		3	10				
Poisoning by venomous animals										1																				2								3			3				
Snake bite		8		2		1								10		11								1		13				4								36		14	50		1		1
Other acute poisonings		1										2	1	6		4	1			1				1								1		1		1	2	8		10	20		1		2
Burns and scalds						6		1		3		2		3	1	5		4		10	1	1		2				1		2		4		4		3	1	23	1	28	53		1		2
Mechanical suffocation																																													
Absorption of irrespirable or poisonous gas																		1																				1			1				
Accidental drowning																																				1				1	1				
Injury by firearms				1	1	5	1	2	1	19		11		5		10						3		7		5		3	1	7	1	34		20	1	29	3	64	3	97	167		14	1	15
Injury by cutting or piercing instruments	1	58	1	5	1	59		6		106		14		91		33	5	231	2	34	2	41	1	24		43		5	2	79	1	7	1	96	1	16	12	804	6	144	966		8		5
Injury by falls	2	15	1	7		14	1	1		31		7		27	1	15	3	34		6	1	20	1	5	1	10		6	2	14		6	1	26	3	4	10	192*	8*	57	267*		2		3
Traumatism by machines						3				2				1	1	1		10		1				1					2	4		3	1	8		1	3	28	1	7	39				
Traumatism by other crushing (vehicles, railways, landslides, etc.)	2	11		1	1	7		5		11		6	3	8		7		7		1	3	64	5	12	2	2			1	18	1	9	1	7	1	1	13	135	7	62	217	1	6		4

CLASSIFICATION OF DISEASES TREATED IN HOSPITALS—*Concluded*

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica				Cuban Divisions				Guatemala Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals*				Total*	Deaths in Hospitals			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
External Causes—*Concluded:*																																													
Injuries by animals (not poisoning)		4				5		1		12				3		1	2	9				2	1	1						7		2		8		1	2	50	1	6	59				
Overexertion																														2		1	1	1			1	3		1	5				
Starvation																1		2																				2		1	3				
Effects of heat																		1																				1			1				
Lightning																																													
Electricity						1		1																														1		1	2				
Homicide by firearms				1																		3		1														3		2	5		3		2
Homicide by cutting or piercing instruments		1																						1														1		1	2		1		1
Homicide by other means																								1																1	1				1
Infanticide																																													
Dislocations						5	1			1	1			2		1		2								1	1					1	1				1	11	4*	2	18*				
Sprains		2				2			1	4		2		1			1	8	1							1		1	2	7		1	2	1	2	1	6	27*	3	5	41*				
Fractures (cause not specified)					1	16		6	1	7		5			2	1	2	28	4	13				1				1	4	6	2	9	1	4	2	5	9	61	10	41	121		2		2
Other external violence:																																													
Criminal abortion																																													
Explosions								1						1		1																	1			1	1	1		3	5				
Salvarsan injection						1						1		1																				1				3		1	4				
Other medicaments (injections)																1																		5		1		5		2	7				
Other external violence	2	24	2	3	1	48	3	5		7			2	53	1	20	10	80	2	10					1	15		2		3		2		4		1	16	234	8	43	301				1
Ill-Defined Diseases:																																													
Sea sickness																																													
Ill-defined organic diseases						5		1		1				1						1									1	1	1	4					1	8	1	6	16				
Sudden death																																													
† No disease; malingering				24		6	2	53				22			1	77	6	25	13	104				28		1	2	26	1	37	10	122	2	13	1	110	9	82	29	566	686				
Infections of undetermined origin						3	1	1										2		1						1		2		20	1	8	2	3	1	3	2	29	3	15	49				
TOTALS	77	691	33	252	88	1906	61	715	62	2297	37	600	57	1731	77	1207	147	1632	107	1213	99	1232	153	980	18	470	11	187	77	1858	105	1218	129	1694	58	978	770	13530	647	7350	22297	12	374	18	363

	Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Totals		Post Operative Deaths
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	
BONES, OPERATIONS ON:																							
Skull, fracture of							3										1		1		5		
Craniectomy, decompressive					1						1										2		
Fractures, simple	12	8	4	3			17	12	42	47	7			5			22	6	7		112	81	
Fractures, comminuted	1	1			1				1		3				1		2		5	1	14	2	
Fractures, compound		1	1		1		2	2	5		9				1				4		23	3	1
Laminectomy							1														1		1
Operations for reduction of fractures	1		2		1		2				4			1							10	1	
Osteotomy	1		3				2		3		2								1	2	12	2	
Osteectomy			1	1	2		2										2		2		9	1	
Resection of elbow									1												1		
Resection, others			2						1								1				4		
Others			3						1	1	4				1						9	1	1
CHEST, OPERATIONS ON:																							
Breast abscess, incision of			2					3			3						8	3	1	8	14	14	
Breast, excision of	1				1					8											2	8	
Breast and axilla, excision of			2				1		1												4		
Thoracotomy					1		20	1	1		4								1		27	1	
Others	11	2	2				1		1								7		4		26	2	
LAPAROTOMY:																							
Abdomen, penetrating wound of	1				1			1			1						2		3		8	1	2
Abscess of liver, laparo-hepatotomy			2		2						1						2				7		1
Appendectomy with local peritonitis	6		28		20		7		84		32				4		15		2		198		3
Appendectomy with general peritonitis	3		1		1				10		9						1				25		2
Cholecystectomy					2				10										1		13		
Cholecystotomy			1				1		1		2										7		
Choledochotomy									2								2				2		1
Colostomy					1		1				1										3		2
Ectopic gestation			1		1						1						3		3		9		
Enterectomy											1										1		1
Entero-enterostomy			2		1		1		2		1										6		1
Enterorrhaphy			1						1		1										3		
Exploratory	3		6		2		3		8		1				5		1		1		30		10
Gastro-enterostomy			2				1		2												5		1
General peritonitis			1		1		1														3		1
Hysterectomy supravaginal			15				1		9								1		6		32		1
Hysterectomy, total									1												1		
Hysterectomy, vaginal									4												4		
Pan-hysterectomy							1		5		1								2		9		1
Hystero-myomectomy			5														1				6		
Hysteropexy			16						2		4						1		2		25		
Hysteropexy with perineorrhaphy					1				1												2		
Intestinal obstruction					1				1						1						3		2
Intussusception, treatment of									1												1		1
Myomectomy			1														1				2		
Ovarian cystectomy			6		1		1		6		5										19		
Oophorectomy									7												7		
Paracentesis abdominalis	23		1				7	4	3	1					3						37	5	
Partial resection of stomach									3												3		
Salpingectomy			1		1				12		2						2		2		20		
Salpingo-oophorectomy	2		6				1		7		7								3		26		1
Splenectomy							1				1										2		1
Others	2		4		6		9	1	3		6						1				31	1	2
OBSTETRICAL:																							
Abortions	7		4		20	1	8	1	6	2	3						13		16		77	4	

CONSOLIDATED SURGICAL REPORT—*Concluded*

	Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia. Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Totals		Post Operative Deaths
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	
OBSTETRICAL—*Concluded:*																							
Births, premature	1		2		11		1		4								3		6		28		
Births, normal	21		40		39		41		68		15				21		85		53		383		
Births, multiple							1		3								2		2		8		
Births, forceps operations	2		1		4		5		9		3						3		2		29		2
Births, abnormal presentations			6		1		4		4								5		4		24		
Births, versions			1		1				7								2		1		12		1
Births, episiotomy			2						4												6		
Births, Caesarean operations							2		2												4		2
Repairs of perineum							5				1										6		
Others			3					1			1								3		7	1	
GENITOURINARY TRACT:																							
Chancroid operations	13	28	3		1	4	14	2	4	7							79	50	12		126	91	
Circumcisions	4		15	1	2		4	1	16		9				4		10		6		70	2	
Curettage uteri			43		2				40		1				1		20		1		108		
Cystotomy			2		1		3		5		1						1				13		2
Epididymectomy																	1				1		
Epididymotomy																	1				1		
Hydrocele, single, radical cure			4				8	1	20		1		1	3			1				35	4	
Hydrocele, double, radical cure			1				1		1		1										4		
Nephrotomy							1														1		
Orchidectomy			2		2				5				1				2				12		1
Penis, operations on	9	3	1		1		2	2	3	3					1		30		2	1	49	9	
Perineorrhaphy			5		1				4						1						11		
Perinephritic abscess									1		1						1		1		4		
Prostatectomy									5								1			1	6	1	1
Scrotum operations			2				5	2			1				1						9	2	
Trachelorrhaphy					1												1		1		3		
Vaginal puncture for pelvic cellulitis			7						1												8		
Vaginal operations			26						2		1				3		1	16	2		35	16	
Varicocele, radical cure			1						2												3		
Urethrotomy, internal					1					3	3						4		6	34	14	37	
Urethrotomy, external					2		2		1					1	3						8	1	1
Others	26	78	41				5	3	2		3								2	3	79	84	
HERNIOTOMY:																							
Femoral			1						2		2						3				8		
Inguinal, single	5		53		5	1	10		39		14		2		6		11		7		152	1	
Inguinal, double	1		7				1		8										4		21		
Strangulated							1		4								2				7		
Umbilical									2												2		
Ventral			1		1				1												3		
Combined									1		1										2		
Others			5				1		2												8		
ADENECTOMY:																							
Axillary	1	2	1		1												5	7			8	9	
Cervical		2	2	1	1						3							4			6	7	
Femoral			4						1		3						6		2		16		
Inguinal, single	5	1	31	12	5	5	8	1	3		9				7		77	40	7		152	59	
Inguinal, double	1		2				3	2			1								1		8	2	
Others			1		1																2		
AMPUTATIONS:																							
Hand									1								3				4		
Forearm					1																1		
Arm	1				4										1		2				8		1
Thigh					2																2		
Leg					1		1		4						2		1				9		2
Foot			1				1				1						1		1		5		
Digits, multiple	2		7	1	4		5	5	26		2			1	6		2		4	1	58	8	

JOINTS, OPERATIONS ON:																							
Arthrotomy			1		1				1		4						1		2		10		1
Reduction of dislocation	1	1	1				2	2		5	6		1	4			4			1	15	13	
Others	2	6	13								5								6	10	26	16	
MUSCLES AND TENDONS, OPERATIONS ON:																							
Tenorrhaphy			3		5		6	1	11	3	4				1		3		1		34	4	
Others								1			3										3	1	
RECTUM, OPERATIONS ON:																							
Fistula in ano			8		2		3		3								3				19		
Hemorrhoids	3		19		2		2	2	9		6		1				14		1		57	2	
Ischio-rectal abscess		3	1				2	1			2			1			3		1		9	5	
Prolapsus recti																			1		1		
Others			22				5		1		1								3		32		1
MISCELLANEOUS:																							
Abscesses, treatment of	25	242	67	415	29	957	145	343	139	717	138	59		84	13	13	174	282	126	459	856	3,571	3
Aneurism, operation for			1												1						2		
Blood transfusions	4																				4		
Carbuncles, treatment of		1	14	157	7	251	6	60	12	258	11		2	1	5		23	2	7	3	87	733	
Cysts	1	4	10	16	3	7	3	3	10	21	3						5		1	1	36	52	1
Fistulous tracts	1		4	2		1	1		1									18	2		9	21	
Nails, extirpation of		1	4	12			2	20	3	17	9			9			1	20	1	27	20	106	
Neoplasm, excision of, Benign			2		2		3	5	9		2				1		2		3	2	24	7	1
Neoplasm, excision of, Malignant				1							1				1				3		5	1	
Plastic operations for severe injuries							1														1		
Plastic operations for congenital defects											4								2		6		
Removal of foreign body	1	8	3	4	1		1	22		44	2			4		8	3			10	11	100	
Skin graft							4				2				1				5		12		
Snake bite, treatment of	10	1					19	4				1					3				32	5	
Thyroidectomy									1												1		
Ulcers, treatment of	247	174	8		5	379	161	3,649	33	214	179	123						114	96	312	729	4,965	
Varicose veins, treatment of	1	2	3	1	1			1		13											5	18	
Wounds, gunshot	3		11		11	108	10	2			16	3			3		41	1	40		135	114	5
Wounds, scalds and burns		33			4	63	8	44	11	105	4						2	39	3	5	32	289	1
Wounds, stab	2	8				3	6	2	11	11	48	26					12		3	2	82	52	
Wounds, others	79	255	14	22	40	394	114	886	404	1,928	67	27		45	30	2	62	256	115	148	925	3,963	6
Various other minor operations	1,025	220	27	37	21	221	50	186	9	37	5	4		1	33	20	16	97	47	174	1,233	997	2
Various other major operations	2	35	1								3										6	35	
EAR, OPERATIONS ON:																							
Abscess, incision of	1	1		1	1		2	5		14				6					1	2	5	29	
Mastoid operations			2				1										1		1		5		
Paracentesis of membrana tympani			1				1	1											13	9	15	10	
Removal of foreign bodies		4		2		2	2	1	1	18							6	137	8	3	17	167	
Others				1					1		35	35							4		40	36	
EYE, OPERATIONS ON:																							
Abscess, incision of		1		1				1		6				6								15	
Cataract, extraction of		8							2						3						5	8	
Chalazion, excision of										1									1	1	1	2	
Enucleation			1						2		1										4		
Hordeolum				5			2	9											3	4	5	18	
Lid operations				1			1	1										2	1	4	2	8	
Pterygium, transplantation of															1		2				3		
Removal of foreign body				16		1		21	4	82	2			4		2	4	136		2	10	264	
Trachoma, treatment of							1			10											1	10	
Others	1		1		2		2	1	2	1	15	11							8		31	13	
NOSE AND THROAT, OPERATIONS ON:																							
Adeno-tonsillectomy					3		3		38		12						18		1		75		
Peritonsillar abscess, incision of			4				2	1		4					3				3	2	12	7	
Removal of polypi			3						1		1								1	1	6	1	
Sinus operations			3				2	1	1												6	1	
Tonsillectomy	11		4				12		67		7				1		4		2		108		
Tracheotomy							1		3		2										6		1
Turbinectomy							1		1												2		
Others	2	1		1						1							3		2		7	3	
SUB-TOTALS	1,588	1,135	706	714	306	2,398	817	5,321	1,346	3,582	795	289	8	176	170	45	865	1,230	715	1,233	7,316	16,123	72
Injections, intravenous	197	414	1,237	729		325	1,246	1,101	753	600	143	109			75	568	691	276	574	399	4,916	4,521	
Tooth extractions	10	135	43	324	1		77	99	56	144	115	63		70	20	92	41	18	21	150	384	1,095	
Vaccinations		478		1	1		2	21		10,805				1,355		60		1,153		7,673	3	21,546	
TOTALS	1,795	2,162	1,986	1,768	308	2,723	2,142	6,542	2,155	15,131	1,053	461	8	1,601	265	765	1,597	2,677	1,310	9,455	12,619	43,285	72

CONSOLIDATED LAB

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica			
	Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.
BLOOD EXAMINATIONS:																
Total examinations	2336	....	1700	....	7951	....	1233	....	5806	....	2035	....	10479	....	3275	....
Leucocyte enumerations	98	....	74	....	712	....	94	....	144	....	30	....	1024	....	203	....
Differential leucocyte counts	79	....	59	....	628	....	72	....	139	....	43	....	861	....	164	....
Erythrocyte enumerations	23	....	49	....	71	....	29	....	3	....	3	....	161	....	45	....
Hemoglobin estimations	974	....	391	....	2695	....	400	....	2644	....	946	....	3552	....	1420	....
Malaria	1143	....	1123	....	3682	....	604	....	2849	....	1003	....	4458	....	1407	....
(a) Estivo-autumnal	....	124	....	123	....	529	....	52	....	632	....	120	....	596	....	253
(b) Tertian	....	145	....	181	....	130	....	38	....	224	....	68	....	10	....	7
(c) Quartan	....	2	....	1	....	6	....	....	....	7	....	4	....	1	....	....
(d) Mixed infection	....	12	....	8	....	8	....	....	....	2	....	1	....	....	....	....
Filaria	....	....	....	....	....	....	....	....	....	....	....	....	12	12	1	1
Widal tests	5	1	....	....	110	22	16	3	20	4	5	2	241	58	6	1
Other examinations	14	....	4	....	53	....	18	1	7	....	5	....	170	4	29	3
URINE EXAMINATIONS:																
Total examinations	1548	....	280	....	3577	....	1440	....	2745	....	345	....	5497	....	1155	....
Albumin	....	773	....	95	....	1934	....	523	....	948	....	71	....	3748	....	528
Casts	....	190	....	13	....	1059	....	141	....	647	....	42	....	2761	....	255
Pus	....	403	....	37	....	1898	....	709	....	1485	....	205	....	4884	....	1009
Blood	....	21	....	5	....	1000	....	358	....	133	....	25	....	864	....	169
Sugar	....	6	....	1	....	20	....	34	....	4	....	11	....	124	....	13
Hemoglobin	....	28	....	1	....	11	....	....	....	46	....	1	....	65	....	1
Gonococci	....	....	....	....	....	1	....	3	....	7	....	19	....	14	....	5
B. tuberculosis	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....
Other examinations	....	9	....	1	284	191	135	76	....	3	....	3	....	344	....	91
SPUTUM EXAMINATIONS:																
Total examinations	243	....	19	....	206	....	86	....	202	....	54	....	1418	....	160	....
B. tuberculosis	242	27	19	2	....	37	....	25	....	41	....	18	....	140	....	33
Pus	....	....	....	....	....	195	....	81	....	185	....	48	....	1203	....	139
Blood	....	1	....	....	....	22	....	1	....	27	....	5	....	56	....	18
Other examinations	1	....	....	....	4	....	....	....	....	....	....	....	....	4	....	....
STOOL EXAMINATIONS:																
Total examinations	1185	....	206	....	1592	....	1122	....	2055	....	652	....	4143	....	814	....
Uncinaria	....	424	....	40	....	724	....	110	....	873	....	132	....	1136	....	43
Trichuris	....	226	....	42	....	469	....	154	....	620	....	188	....	888	....	152
Ascaris	....	108	....	21	....	162	....	48	....	591	....	150	....	704	....	146
Oxyuris vermicularis	....	4	....	2	....	....	....	....	....	4	....	3	....	2	....	....
Strongyloides stercoralis	....	64	....	6	....	114	....	57	....	16	....	6	....	190	....	19
Taenia saginata	....	....	....	....	....	2	....	....	....	2	....	4	....	1	....	3
Taenia solium	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....
Other tape-worms	....	2	....	....	....	3	....	4	....	3	....	5	....	6	....	1
Entamoeba histolytica	....	14	....	....	....	476	....	453	....	380	....	151	....	275	....	100
Other entamoebae	....	9	....	....	....	117	....	180	....	28	....	4	....	285	....	78
Balantidium coli	....	....	....	....	....	4	....	....	....	10	....	5	....	4	....	2
Flagellates, intestinal	....	6	....	....	....	363	....	315	....	176	....	80	....	206	....	88
Blood	....	7	....	....	....	62	....	57	....	363	....	181	....	295	....	109
Pus	....	9	....	....	....	60	....	66	....	531	....	232	....	347	....	129
Other examinations	....	1	....	....	9	4	....	....	....	....	....	....	....	510	....	203
MISCELLANEOUS SMEARS:																
Total examinations	40	....	38	....	168	....	429	....	23	....	62	....	606	....	264	....
Eye	2	1	1	1	13	7	11	5	6	4	1	1	32	10	19	1
Throat	....	....	....	....	10	5	31	17	3	....	....	....	20	7	16	9
Gums and mouth	....	....	1	1	4	4	13	4	1	1	1	1	1	1	....	....
Nose	....	....	....	....	26	4	20	2	....	....	....	....	34	....	13	4
Ear	....	....	....	....	....	....	....	....	....	....	....	....	8	....	1	....
Genital source (gonococcus)	38	15	34	15	73	27	327	108	9	6	58	26	282	127	184	83
Cutaneous ulcer	....	....	1	1	7	3	6	1	1	....	....	....	14	8	....	....
Other smears	....	....	1	1	35	11	21	5	3	....	2	1	215	56	31	5
EXAMINATION FOR SYPHILIS:																
Total examinations	565	....	285	....	1434	....	1307	....	193	....	351	....	2500	....	622	....
Complement fix. test (blood)	....	....	....	....	674	235	633	145	....	....	....	....	2217	665	506	145
Flocculation test (blood)	559	178	282	98	698	279	642	171	189	72	350	132	247	154	100	68
Dark-field examination	....	....	2	....	13	4	28	11	....	....	....	....	18	....	14	3
Spinal-fluid test	6	4	1	1	49	15	4	1	4	....	1	....	18	7	2	1
CULTURES:																
Total examinations	20	....	1	....	311	....	75	....	26	....	10	....	1141	....	20	....
Blood	11	3	....	....	142	44	49	19	1	....	1	....	165	20	2	1
Urine	....	....	....	....	63	9	3	....	1	....	....	....	179	43	4	4
Sputum	1	....	....	....	....	....	....	....	....	....	....	....	5	5	....	....
Stool	1	....	....	....	76	4	10	2	6	....	1	....	754	13	6	1
Fluid from joint	1	....	....	....	1	....	....	....	4	2	1	....	....	....	....	....
Spinal fluid	1	....	....	....	5	....	....	....	2	2	....	....	21	2	....	....
Pleural fluid	1	....	....	....	5	....	....	....	4	1	....	....	1	1	....	....

RATORY REPORT

Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad			
Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.
5250		19556		3845		814		10		57		1616		830		3988		5968		5167		2123	
544		57		310		11		1		1		143		58		351		100		293		64	
191		19		297		13				4		29		20		112		39		290		44	
44		25		101								15		18		7		3		46		19	
505		151		105		6				15		667		63		225		210		150		63	
3701		19274		2840		784		9		37		747		669		3216		5588		4388		1933	
	357		2570		361		76				2		139		131		538		419		833		310
	9		47		322		117		1		14		7		9		132		267		232		103
	1		8		35		7						3		1		28		18		3		10
					122		37										20		5		29		22
3	1																						
119	53	7	2	59	6							7	4			71	19	19					
143		23		133								8		2	1	6		9					
4022		1576		3894		251		22		288		1128		502		3413		853		3331		753	
	1000		276		805		43	11	2	135	24	1128	630	502	161		809		95		1411		255
	324		46		782		43	1	1	5	3	1128	438	502	132		462		40		710		48
	1032		378		1033		86			1	1	1128	1121	502	489		799		162		2847		649
	159		53		50		1			3		1128	55	502	5		137		26		232		51
	14	5	9		33		17	10		118	8	64	61	58	3		6		12		22		3
	21				71		2			1		2	1				14				61		1
	1				13							3		3			7		3				
							1			13							5		1				
7	4	3	1	45	17					12	12	25	23	3	3		21		4	165	409	27	90
119		41		349		25		3				94		16		321		58		623		5	
	20		2		61		5					94	9	16	2		69		18	623	108	5	2
	3																						
	18		3						3														
1	1			3	2																		
2101		919		3963		314		1		21		668		178		2963		1049		2785		234	
	160		104		800		57			12		668	214	178	56		1202		231		1479		59
	254		236		758		50					668	363	178	85		1350		570		297		49
	133		152		834		51			3	3	668	40	178	20		1305		500		298		46
	4		2				1					668	3	178									3
	47		13		116		9					668	37	178	3		191		47				
	1				4		4					668		178			9				3		
												668		178							3		1
							3					668		178			8		1		1		
	2		2		141		6					13	1	4	3		140		68		31		4
	3		5		34		4			3	1	668		178			222		66				
	1		4		7		1					668	3	178			12						
	3		4		91		11					668	29	178	1		157		59				
	37		7		150		5	1		3		668	9	178	2		135		57		106		20
	46		8		411		38					668	9	178	2		80		28		113		25
29	17	3	3	26	23							119		36			359		144		59		13
61		47		264		54				4		47		153		117		182		79		119	
6	1			67	54	9	8							3	3	33	17	35	15			1	1
2	1	1		8								1	1			1		3	2			2	2
												2	2	8	3	1	1	2	2	1	1	12	10
7		4		7										3	1			1					
		2																					
30	12	32	20	172	130	45	30			4	4	44	13	132	60	81	25	128	21	46	20	104	50
2				8	3									5				13	7				
14	5	8	7	2	2									2	1	1	1			32	27		
485		380		265		42						83		226		1443		750		733		249	
477	179	379	66	241	74	38	17					75	40	226	124	1440	324	749	170	730	92	245	38
7	2	1	1	11	5	4	3											1		1		4	
1				13	7							8	5			3	3			2			
59		5		1		1										107		72		4			
45	10			1												40	5	18		2			
																33	19	8	7				
																18	3	23					
2	1															8	2						
1																1	1			1	1		

CONSOLIDATED LABORA

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica			
	Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.
CULTURES—*Concluded*																
Throat	1	1	.....	.....	17	15	11	7	.....	.....	2	.....	12	.....	8	.....
Other sources	2	1	1	1	2	2	2	1	8	.....	5	.....	.....	.....	.....	.....
Autopsy sources	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	3	.....	.....
MISCELLANEOUS:																
Total examinations	89	.....	62	.....	365	.....	294	.....	68	.....	.....	.....	724	.....	8	.....
Autopsies performed	14	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	21	16	.....	.....
Surgical tissues reported	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reports of progress on special problems	.....	.....	.....	.....	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number of x-ray examinations	73	.....	60	.....	351	.....	239	.....	68	.....	.....	.....	666	.....	.....	.....
Other examinations	2	1	1	1	3	2	55	.....	.....	.....	.....	.....	37	8	8	.....
TOTALS	6026	2820	2591	699	15604	10293	5986	3988	11118	8080	3509	1946	26508	20884	6318	3924

NOTE.—The results of examinations made during malaria blood surveys are not included in this table, but are briefly summarized on pages 289 and 290 of this Report.

ORY REPORT—*Concluded*

Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad			
Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.	To-tal	Pos.
9	2	5	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	1	21	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	2	.....	1	1	.....	.....
2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
648	.....	.....	.....	314	.....	15	.....	.....	.....	.....	.....	36	.....	12	.....	14	.....	3	.....	228	.....	1	.....
28	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	45	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7	2	2	.....	3	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
617	.....	.....	.....	310	.....	15	.....	.....	.....	.....	.....	28	.....	12	.....	.....	.....	.....	.....	178	.....	.....	.....
3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	.....	.....	.....	4	1	1	.....	2	.....	1	.....
12745	3941	22524	4030	12895	7357	1516	733	36	7	370	72	3672	3260	1917	1301	12366	8643	8935	3065	12950	9429	3484	1870

CLASSIFICATION OF TREATMENTS

Note: This table shows the number of treatments administered at the Hospital

	Chiriqui Land Co.				Colombia Division				Cortes Development Company				Cia. Bananera Costa Rica			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Epidemic, Endemic or Infectious Diseases:																
Malaria or cachexia (No. 5)	109	356	10	171	330	4727	9	495	120	4365	17	1135	20	976	2	582
Influenza (No. 11)	...	10	1	2	402	5222	5	301	81	3081	11	646	58	997	7	252
Dysentery (No. 16)	...	14	...	11	109	2027	29	575	39	537	4	239	8	294	6	360
Venereal infections (Nos. 38 to 40, incl.)	32	715	9	146	173	2454	23	282	71	1468	13	389	82	1834	32	626
Other endemic or infectious diseases (Nos. 1 to 42, incl., excepting Nos. 5, 11, 16, and 38 to 40, incl.)	5	4	...	39	....	114	4	178	3	79	...	120	24	95	1	155
General Diseases Not Included Above:																
Cancer (Nos. 43 to 49, incl.)	...	1	...	1	....	.....	...	1	...	1	...	6	...	1	...	...
Benign tumors, and tumors not returned as malignant (No. 50)	...	....	...	....	....	60	...	43	...	16	...	5	...	3	...	3
Rheumatism or gout (Nos. 51 and 52)	8	134	1	14	124	1695	1	39	7	343	3	49	21	998	11	255
Anemia, chlorosis (No. 58)	4	35	3	19	1	374	2	83	...	19	...	4	7	285	26	341
Other general diseases (Nos. 43 to 69, incl., excepting Nos. 43 to 52, incl. and No. 58)	1	....	...	1	4	78	5	79	...	28	1	22	1	15	3	3
Diseases of the Nervous System and of the Organs of Special Sense:																
Diseases of the nervous system (Nos. 70 to 84, incl.)	13	29	21	21	5	661	15	128	3	168	1	61	10	230	8	139
Diseases of the organs of vision and adnexa (No. 85)	16	60	1	18	65	857	4	70	12	382	1	96	6	303	5	188
Diseases of the organs of hearing and the mastoid process (No. 86)	19	28	2	16	5	176	19	76	16	252	4	107	16	168	4	234
Diseases of the Circulatory System:																
Organic diseases of the heart (Nos. 87 to 90, incl.)	2	27	1	11	1	61	10	63	3	10	...	12	14	24	2	27
Other diseases of the circulatory system (Nos. 87 to 96, incl., excepting Nos. 87 to 90, incl.)	9	52	5	19	3	281	17	107	7	164	1	33	79	242	2	174
Diseases of the Respiratory System:																
Bronchitis (No. 99)	60	337	15	72	11	1174	12	350	23	1003	15	140	8	865	4	477
Pneumonia and pleurisy (Nos. 100 to 102, incl.)	...	2	...	....	1	27	2	32	...	11	...	9	2	44	...	34
Other diseases of the respiratory system (Nos. 97 to 107, incl., excepting Nos. 99 to 102, incl.)	84	301	9	23	4	595	6	118	22	587	2	91	3	429	3	203
Diseases of the Digestive System:																
Diseases of the mouth and adnexa (No. 108)	15	162	4	46	42	971	6	43	5	369	1	41	4	154	3	64
Diarrhea and enteritis (Nos. 113 and 114)	9	61	3	29	5	362	14	252	14	412	1	216	18	166	1	230
Ankylostomiasis (No. 115)	...	....	...	....	104	1080	1	90	1	69	...	73	1	23	1	55
Other diseases of the digestive system (Nos. 108 to 127, incl., excepting No. 108, and Nos. 113 to 115, incl.)	91	462	14	144	448	5066	48	732	73	839	7	436	68	1573	31	1069
Non-Venereal Diseases of the Genitourinary System and Its Adnexa:																
Nos. 128 to 142, incl.	13	139	21	105	2	550	47	456	17	136	11	172	14	381	9	475
The Puerperal State:																
Nos. 143 to 150, incl.	...	....	2	18	....	.....	...	16	1	10	5	120	...	7	...	16
Diseases of the Skin and of the Cellular Tissue:																
Boil, carbuncle, furuncle (No. 152)	13	23	8	20	26	619	18	33	30	545	2	157	16	127	...	91
Phlegmon, acute abscess (No. 153)	6	153	2	82	30	1035	10	258	24	660	...	209	10	487	1	613
Ground itch	...	....	...	....	....	7	...	1	14	156	...	20	...	7	...	2
Ulcer of the skin	6	161	...	7	36	3543	...	55	2	657	1	81	1	3032	1	1485
Other diseases of the skin or cellular tissue, and adnexa (Nos. 151 to 154, incl., excepting Nos. 152 and 153, and "Ground itch" and "Ulcer of the skin")	137	211	19	52	300	2012	23	322	63	773	5	167	21	1036	9	566
Diseases of the Bones and of the Organs of Locomotion:																
Nos. 155 to 158, incl.	5	36	6	11	3	557	7	44	3	642	...	72	2	215	1	22
Malformations:																
No. 159	...	....	...	....	....	.....	...	1	...	.....	...	....	...	.....	...	1
Diseases of Early Infancy:																
Nos. 160 to 163, incl.	...	....	...	4	....	.....	...	11	...	.....	...	10	...	.....	...	23
Old Age:																
No. 164	...	....	...	1	....	.....	...	1	...	.....	...	....	...	.....	...	2
External Causes:																
Injury by firearms (No. 183)	...	....	...	....	....	4	...	....	...	30	...	17	...	42	...	32
Injury by cutting or piercing instruments, and by falls (Nos. 184 and 185)	19	208	10	29	87	1952	2	92	20	1126	6	164	1	1200	1	361
Traumatism by machines and other means (Nos. 187 and 188)	2	23	...	....	....	178	...	11	2	228	...	27	2	263	...	6
Dislocations, sprains, fractures (No. 201)	...	4	2	1	....	29	2	7	3	41	1	43	...	120	...	72
Other external causes (Nos. 165 to 203, incl., excepting Nos. 183 to 185, incl., 187, 188, and 201)	20	126	2	30	8	1090	3	80	14	127	6	33	2	669	1	249
***Ill-Defined Diseases:**																
*Nos. 204 and 205	2	257	6	222	....	91	...	57	...	3	...	....	...	8	18	138
TOTALS	700	4131	177	1385	2329	39729	344	5582	693	19337	119	5222	519	17313	193	9625

NOTE.—This table shows the number of *treatments*, and not the number of *cases* treated, in our Hospital Dispensaries. The chart numbers
city and state health departments and organizations.

* Under "Ill-Defined Diseases" (Charts Nos. 204 and 205) some Divisions have included (a) persons who were found to be without physical
and of aliens who were prospective passengers aboard the steamships; (d) laboratory examinations made upon request, with no physical examina
came to the dispensaries without any stated or ascertained symptoms or physical signs of disease, but who obtained medicines, surgical supplies,

IN HOSPITAL DISPENSARIES

Dispensaries (by qualified physicians), and does not record the number of cases

Cuban Divisions				Guatemala Division				Jamaica Division				Panama Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp		Non-Fmp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
102	3100	15	3981	221	1128	234	603	84	2828	9	991	17	147	...	83	28	1176	26	750	32	519	14	1402	1063	19322	336	10193	30914
99	1582	76	2144	37	83	23	23	134	650	37	78	46	558	12	161	42	403	9	68	53	380	18	130	952	12966	199	3805	17922
....	12	....	1	....	....	....	....	22	9	....	1	...	2	6	....	17	119	19	233	2	26	1	58	197	3040	65	1478	4780
16	402	....	198	....	129	....	44	1	196	3	5	2	638	...	153	85	990	142	415	13	628	8	164	475	9454	230	2422	12581
1	184	21	196	....	....	....	....	3	73	....	24	...	32	...	34	....	64	1	59	....	6	...	22	36	651	27	827	1541
....	6	....	7	....	....	....	....	....	....	....	....	...	5	...	....	....	....	....	....	....	1	...	9	....	15	....	24	39
....	66	....	24	....	....	....	....	....	....	....	....	...	14	4	1	....	....	....	....	1	47	...	48	1	206	4	124	335
34	722	3	382	52	258	50	109	2	257	....	3	2	228	...	21	2	46	4	80	2	14	...	10	254	4695	73	962	5984
9	412	6	1078	....	....	....	....	39	150	23	26	...	1	...	1	25	213	30	290	2	52	2	66	87	1541	92	1908	3628
3	40	2	43	....	....	....	....	1	7	....	1	3	27	...	5	53	120	16	157	....	9	2	18	66	324	29	329	748
14	590	11	685	....	....	....	....	40	427	18	18	3	63	...	20	23	102	7	74	20	79	19	84	131	2349	100	1230	3810
24	695	22	558	15	56	9	22	17	215	6	16	18	79	4	16	48	284	26	155	38	171	14	54	259	3102	92	1193	4646
23	193	18	257	10	23	7	9	24	144	11	19	5	26	1	28	85	194	36	171	21	77	16	83	224	1281	118	1000	2623
6	106	3	127	....	....	....	....	3	26	1	1	1	29	1	12	....	....	....	1	1	7	3	9	31	290	21	263	605
8	263	2	398	1	....	....	....	2	74	2	6	1	55	1	42	9	750	104	81	2	15	2	10	121	1896	136	870	3023
27	259	19	650	76	145	82	75	1	124	....	....	...	28	5	26	104	2595	48	979	94	449	33	338	404	6979	233	3107	10723
....	53	....	109	....	....	....	....	....	23	....	1	...	12	1	11	....	....	....	3	1	11	...	13	4	183	3	212	402
22	334	21	426	4	12	10	10	21	432	1	97	9	167	5	75	51	216	27	88	71	662	13	219	291	3735	97	1350	5473
11	529	5	703	9	76	....	27	2	280	7	10	3	111	3	28	5	135	4	22	10	162	16	88	106	2949	49	1072	4176
14	101	13	893	....	7	....	2	6	52	18	18	4	11	3	14	14	186	4	153	4	24	4	70	88	1382	61	1877	3408
....	7	....	137	....	....	....	....	....	2	....	....	...	19	1	77	2	100	2	126	....	10	1	24	108	1310	6	582	2006
108	1518	64	3210	171	186	184	126	118	1574	59	144	25	297	20	101	131	1194	67	712	112	578	37	373	1345	13287	531	7047	22210
11	219	9	1159	....	....	....	....	20	194	19	36	4	144	40	150	118	287	196	604	26	85	28	194	225	2135	380	3351	6091
....	....	21	519	....	....	....	....	....	3	....	....	...	2	...	26	....	9	8	46	....	1	1	34	1	32	37	795	865
129	663	24	689	....	....	....	....	13	109	8	5	17	113	3	13	112	461	35	269	2	9	7	....	358	2669	105	1277	4409
48	2023	33	1340	2	26	6	26	20	414	10	18	10	46	...	61	44	286	77	257	69	946	55	678	263	6076	194	3542	10075
....	9	....	8	....	....	....	....	....	....	....	....	...	....	...	....	....	....	....	....	....	8	...	1	14	187	....	32	233
10	1189	....	520	5	345	3	118	....	533	2	99	1	173	...	18	84	632	76	592	5	770	2	404	150	11035	85	3379	14649
91	1544	56	2508	106	5	64	....	45	299	9	52	47	303	19	130	204	1184	123	538	179	893	103	501	1193	8260	430	4836	14719
....	50	7	60	....	....	....	....	3	76	....	1	...	67	1	10	13	520	1	95	16	279	5	39	45	2442	28	354	2869
....	....	....	7	....	....	....	....	....	....	....	....	...	....	...	....	....	....	....	....	....	....	...	1	....	....	....	10	10
....	....	....	70	....	....	....	....	....	....	....	5	...	....	...	17	....	....	....	1	....	....	...	14	....	....	....	155	155
....	27	....	18	....	....	....	....	....	....	....	....	...	....	...	....	....	....	....	....	....	....	...	1	....	27	....	23	50
....	....	....	....	....	1	....	2	....	....	....	....	...	12	...	6	....	1	....	81	....	14	...	4	....	104	....	142	246
198	6033	52	2296	....	26	....	12	37	1761	27	38	6	452	4	87	67	711	77	301	39	843	43	149	474	14312	222	3529	18537
108	1203	45	373	....	7	....	7	5	360	4	6	5	18	...	13	49	190	19	62	1	67	2	....	174	2537	70	505	3286
3	82	4	105	....	....	....	....	8	181	4	5	4	35	1	4	6	20	....	13	6	40	7	12	30	552	21	262	865
108	959	79	1088	9	81	2	17	90	738	27	1408	11	422	11	114	11	125	....	64	8	109	1	78	281	4446	132	3161	8020
139	2075	473	8647	....	....	....	....	22	22	16	113	181	250	84	425	223	683	170	671	782	5164	275	3549	1349	8553	1042	13822	24766
366	27250	1104	35614	718	2594	674	1232	783	12233	321	3245	425	4586	230	1983	1655	13996	1354	8211	1612	13155	732	8951	10800	154324	5248	81050	251422

sed are taken from the "International List of Causes of Sickness and Death." These chart numbers are used universally by public-health and

ilment of any kind, or who were malingering; (b) vaccinations against smallpox and typhoid; (c) medical examinations of prospective employees
on of the individual from whom the specimen was obtained; (e) obstetrical patients who came for periodical examinations; and (f) persons who
pecial foods for infants, and other similar articles.

NUMBER AND CLASSIFICATION OF X-RAY EXAMINATIONS*

Nature of Examinations	Chiriqui Land Co.		Colombia Division		Cortes Development Company		Cia Bananera Costa Rica		Cuban Divisions		Guatemala Division		Jamaica Division		Panama Division		Tela Railroad		Truxillo Railroad		Totals*	
	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used	Number of Examinations	Plates and Films Used
Vertebral column	7	7	12	13	....	....	28	36	5	6	12	13	....	....	....	....	14	?	....	....	78	75
Skull	2	3	38	41	3	4	48	57	15	20	22	23	....	....	2	2	1	?	2	2	133	152
Sternum	1	2	....	....	....	....	....	....	....	....	4	4	....	....	....	....	....	....	....	....	5	6
Hyoid bone	....	....	....	....	....	....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	1	1
Ribs	....	....	11	11	2	4	19	19	10	10	14	14	....	....	....	....	....	....	....	....	56	58
Upper limbs	42	51	89	84	28	44	155	198	135	146	76	81	....	....	13	13	46	?	15	16	599	633
Lower limbs	22	26	61	61	27	44	137	182	126	145	67	70	....	....	9	9	47	?	39	43	535	580
Neck	....	....	7	11	....	....	4	7	1	1	2	3	....	....	4	4	....	....	....	....	18	26
Teeth	20	39	26	31	....	....	23	102	30	47	4	8	....	....	....	....	2	?	5	14	110	241
Heart	2	2	24	24	....	....	4	4	8	7	9	9	....	....	....	....	202	?	....	....	249	46
Lungs	24	31	218	193	5	5	163	171	193	206	74	74	....	....	7	7	202	?	4	4	890	691
Liver	....	....	11	11	....	....	4	5	15	31	2	2	....	....	....	....	....	....	1	2	33	51
Spleen	....	....	....	....	....	....	3	9	....	....	....	....	....	....	....	....	....	....	....	....	3	9
Kidney	2	3	13	14	1	2	8	12	10	16	14	14	....	....	....	....	11	?	....	....	59	61
Gastro-intestinal tract	3	6	48	41	....	....	22	37	44	87	17	43	....	....	....	....	21	?	1	1	156	215
Pelvic organs	6	9	17	17	1	2	24	28	13	17	2	2	....	....	5	5	7	?	2	2	77	82
Miscellaneous	2	2	15	15	1	1	24	....	12	12	5	5	....	....	....	....	2	?	109	....	170	35
TOTALS	133	181	590	567	68	106	666	867	617	751	325	366	....	....	40	40	555	?	178	84	3,172	2,962

* NOTE.—The figures appearing in the "Totals" column, under the heading "Plates and Films Used," are incomplete, inasmuch as the Tela Railroad Company's Medical Department has not supplied data in their reports to record the number of plates and films used in the Tela Hospital in examining the respective organs. Fluoroscopic examinations are included in the columns entitled "Number of Examinations." No x-ray apparatus has been installed in the Jamaica Division, as the Company has no Hospital there.

METEOROLOGICAL REPORT

AVERAGE TOTAL RAINFALL (INCHES)

Month	Chiriqui Land Co.	Colombia Division	Cortes Development Company	Cia. Bananera Costa Rica	Cuban Divisions		Guatemala Division	Jamaica Division	Panama Division	Tela Railroad	Truxillo Railroad	Average for all Divisions
					(Banes)	(Preston)						
January	1.46	.00	4.54	8.67	3.45	6.39	5.42	5.08	9.91	8.00	8.05	5.54
February	.23	.08	2.11	3.81	1.92	2.06	5.56	2.58	2.10	2.67	5.94	2.64
March	1.89	1.73	3.17	16.64	.27	1.36	3.03	2.42	14.33	4.31	8.28	5.22
April	4.74	4.96	2.63	5.28	9.96	8.71	3.98	5.77	8.16	3.83	6.85	5.91
May	15.32	10.12	1.31	9.12	11.04	12.02	5.72	8.00	7.84	2.79	4.87	8.01
June	12.90	9.36	4.81	11.41	10.32	11.22	11.45	7.84	9.13	5.03	8.53	9.27
July	15.73	16.40	8.98	7.53	2.78	2.88	12.16	13.68	8.15	10.88	10.16	9.94
August	8.39	2.38	5.49	10.32	.88	1.26	11.06	4.36	10.34	6.81	12.14	6.68
September	13.06	10.94	5.70	9.33	4.07	5.03	8.36	7.49	5.39	5.02	9.43	7.62
October	16.98	8.36	10.61	8.22	7.53	7.73	17.47	13.27	3.23	14.19	13.24	10.98
November	8.98	9.40	2.99	10.33	7.47	8.61	2.94	9.99	5.22	4.53	16.88	7.94
December	3.11	.80	2.09	7.30	2.73	2.11	5.26	3.69	10.13	2.41	6.07	4.15
TOTALS	102.79	74.53	54.42	107.96	62.42	69.38	92.41	84.17	93.93	70.47	110.44	83.90

MEAN TEMPERATURE (FAHRENHEIT)

January	80.50	79.00	76.00	69.00	72.50	67.50	73.50	70.50	81.00	77.00	80.00	75.14
February	80.00	80.00	78.50	70.00	73.50	68.50	74.00	70.00	78.50	74.00	77.00	74.91
March	84.50	82.00	80.00	79.00	74.50	71.50	76.50	70.00	80.50	78.00	78.50	77.73
April	83.00	82.50	78.00	79.50	78.50	73.50	77.50	72.00	81.00	77.50	77.00	78.18
May	83.00	81.50	81.50	75.00	78.00	77.50	81.00	73.00	82.00	80.00	81.00	79.41
June	83.00	82.50	84.50	76.50	78.50	77.50	83.50	73.50	81.50	81.50	81.00	80.32
July	82.00	81.50	84.00	78.50	80.00	76.50	77.50	74.00	81.50	82.50	81.00	79.91
August	82.00	81.50	82.00	75.00	81.50	78.00	81.50	76.50	81.50	82.00	80.00	80.14
September	81.00	81.00	83.00	75.50	81.00	79.00	80.50	74.50	81.50	79.00	81.00	79.73
October	82.00	82.00	81.00	72.50	81.00	75.50	80.00	72.00	81.50	79.50	80.50	78.86
November	80.00	80.00	78.00	71.50	78.50	72.50	74.50	72.00	78.50	74.50	77.50	76.14
December	80.00	79.50	81.00	72.50	72.50	68.00	77.00	73.50	79.00	77.00	80.00	76.36
Average maximum temperature	96.33	91.00	95.58	97.00	96.58	93.75	93.92	91.75	93.25	97.17	94.33	94.61
Average minimum temperature	67.17	71.17	65.67	52.08	58.42	53.83	62.25	53.50	68.08	59.92	64.75	61.53
Average mean temperature	81.75	81.08	80.63	74.54	77.50	73.79	78.09	72.63	80.66	78.55	79.54	78.07

REPORT OF PORT MEDICAL OFFICERS AND SANITARY INSPECTOR

MEDICAL AND SURGICAL CASES TREATED

	Medical Cases			Surgical Cases			Totals	
	No. of Cases		No. of Treatments	No. of Cases		No. of Treatments	No. of Cases	No. of Treatments
	Emp.	Non-Emp.		Emp.	Non-Emp.			
New York	126	....	216	819	19	3,219	964	3,435
New Orleans	1,101	25	2,664	606	20	2,183	1,752	4,847
Boston Long Wharf	223	....	327	324	....	573	547	900
Revere Refinery	1,813	....	563	1,479	....	2,641	3,292	3,204
TOTALS	3,263	25	3,770	3,228	39	8,616	6,555	12,386

PHYSICAL EXAMINATION OF PROSPECTIVE EMPLOYEES

	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York	386	52	13.47
New Orleans	84	11	13.10
Boston	63	1	1.59
TOTALS	533	64	12.01

PHYSICAL EXAMINATION OF MEMBERS OF CREWS

	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York	13,786	98	.71
New Orleans	11,646	134	1.15
Boston	2,708	4	.15
TOTALS	28,140	236	.84

PHYSICAL CAUSES FOR REJECTION OF MEMBERS OF CREWS

	New York	New Orleans	Boston
Syphilis, period not specified	7	2	....
Soft chancre	6	15	1
Gonococcal infection, except that of the eye	22	67	1
Alcoholism	1	....	....
Follicular conjunctivitis	1	....	....
Other diseases of the eye or its adnexa	3	1	....
Other chronic diseases of the heart	2	....	....
Diseases of the veins	4	....	....
Diseases of the teeth and gums	9	....	....
Tonsillitis	1	....	....
Ulcer of the stomach	....	1	....
Hernia	21	46	2
Other diseases of the liver	1	....	....
Non-venereal diseases of the male genital organs	1	....	....
Furuncle	1	....	....
Scabies	3	1	....
Other diseases of the skin and adnexa	7	1	....
Other diseases of the bones or organs of locomotion	4	....	....
Injury by cutting or piercing instruments	2	....	....
Traumatism by other crushing	1	....	....
Infections of undetermined origin	1	....	....
TOTALS	98	134	4

VACCINATIONS

New York	876
New Orleans	1,094
Boston	305

FUMIGATIONS

	New York	New Orleans	Boston
Steamships fumigated throughout	49	32	17
Holds only	....	....	....
Superstructure only	....	....	....
Forward quarters	....	1	3
Aft quarters	....	....	6
Separate rooms	10	6	4

GENERAL STATEMENT PASSENGER SERVICE

NEW YORK PASSENGER STEAMSHIPS

	Calamares	Carrillo	Castilla	Metapan	Pastores	Santa Marta	Sixaola	Tivives	Toloa	Ulua	Zacapa	Total
Number of voyages made	16	14	7	14	11	16	11	16	16	15	14	150
Total number of officers, all voyages	397	286	106	288	271	324	224	309	390	361	290	3.246
Total number in crews, all voyages	1,498	874	334	912	1,007	975	711	938	1,448	1,375	920	10,992
Total number of ships' laborers, all voyages	208	107	.....	229	225	62	197	70	195	204	230	1,727
Number of seamen given physical examination before "Signing-on"	1,491	868	334	906	982	972	708	934	1,438	1,369	917	10,919
Number of rejected applicants, "Signing-on" day	9	1	20	1	1	1	1	.....	.....	3	4	41
Number of prospective passengers rejected at tropical ports	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number of cabin passengers carried	3,233	1,255	439	1,657	2,046	1,222	1,383	1,192	2,996	2,602	1,590	19,615
Number of deck passengers carried	226	649	.....	395	326	478	412	731	213	212	450	4,092
OFFICERS, CREWS AND SHIPS' LABORERS:												
Total number of patients treated	352	207	44	192	134	183	105	326	223	326	304	2,396
Total number of treatments in office	743	301	98	430	334	302	202	721	565	650	548	4,894
Total number of treatments in quarters	99	152	18	15	24	52	43	70	141	49	129	792
PASSENGERS:												
Total number of patients treated	215	37	25	88	65	95	52	72	74	157	96	976
Total number of treatments in office	222	45	38	86	82	78	60	136	86	212	158	1,203
Total number of treatments in staterooms	141	81	22	72	181	86	119	100	103	96	99	1,100
Number of vaccinations	42	745	17	81	24	416	47	725	8	24	130	2,259
Number of persons detained by quarantine and immigration authorities	1	.....	1	1	.....	1	1	.....	3	1	3	12
*Number of deaths Members of crews	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....	2
Passengers	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	2

---

* The deaths aboard steamships of the New York Division were caused by: acute dilatation of heart, 2; angina pectoris-myocarditis, 1; shock from extensive burns, 1 (member of crew of the S.S. Ruth Kellogg, Kellogg Steamship Co.).

NEW ORLEANS PASSENGER STEAMSHIPS

	Abangarez**	Atenas	Cartago	Castilla	Coppename	Heredia	Iriona	Parismina	Tela	Turrialba	Total
Number of voyages made	20	25	21	6	5	23	3	23	1	25	152
Total number of officers, all voyages	382	487	416	77	94	451	46	456	16	470	2,895
Total number in crews, all voyages	956	1,279	1,060	196	200	1,141	111	1,158	38	1,192	7,331
Total number of ships' laborers, all voyages	301	146	164	19	21	242	.....	214	.....	182	1,289
Number of seamen given physical examination before "Signing-on"	925	1,288	1,069	193	200	1,151	112	1,163	38	1,202	7,341
Number of rejected applicants, "Signing-on" day	6	8	9	1	.....	7	.....	7	.....	11	49
Number of prospective passengers rejected at tropical ports	1	.....	1	.....	.....	.....	.....	1	.....	.....	3
Number of cabin passengers carried	1,778	1,922	2,331	243	273	2,384	133	2,426	19	1,806	13,315
Number of deck passengers carried	334	125	143	20	8	141	8	114	.....	158	1,051
OFFICERS, CREWS AND SHIPS' LABORERS:											
Total number of patients treated	403	392	298	71	90	295	39	304	15	354	2,261
Total number of treatments in office	551	478	359	111	136	366	60	358	19	492	2,930
Total number of treatments in quarters	78	30	27	.....	26	29	11	17	.....	40	258
PASSENGERS:											
Total number of patients treated	99	83	149	21	20	60	7	58	1	107	605
Total number of treatments in office	109	108	172	23	30	59	9	35	1	103	649
Total number of treatments in staterooms	36	24	48	5	.....	59	2	48	.....	33	255
Number of vaccinations	166	96	178	77	26	110	9	188	.....	176	1,026
Number of persons detained by quarantine and immigration authorities	14	2	17	.....	3	13	1	35	.....	10	95
* Number of deaths Members of crews	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Passengers	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2

---

* The deaths aboard steamships of the New Orleans Division were caused by: acute myocarditis, 1; acute alcoholism, 1.

** These records include one trip beginning and ending at New York, N. Y.; and one voyage between New York, N. Y., and New Orleans, La.

GENERAL STATEMENT PASSENGER SERVICE—*Concluded*

CLASSIFICATION OF DISEASES TREATED ABOARD PASSENGER STEAMSHIPS AND BY PORT MEDICAL OFFICERS AT NEW YORK, NEW ORLEANS AND BOSTON*

	Steamships N. Y. Division		Steamships N. O. Division†		Port Med. Officer New York		Port Med. Officer New Orleans		Port Med. Officer Boston		Revere Sugar Refinery Boston	
	Crew	Pass.	Crew	Pass.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.
Epidemic, endemic or infectious diseases (Chart Nos. 1 to 42, incl.)	128	42	33	17	23	.....	23	4	14	.....	.....	.....
General diseases not included above (Chart Nos. 43 to 69, incl.)	45	36	14	18	9	.....	2	1	3	.....	.....	.....
Diseases of the nervous system and of the organs of special sense (Chart Nos. 70 to 86, incl.)	239	118	74	15	75	2	48	1	63	.....	401	.....
Diseases of the circulatory system (Chart Nos. 87 to 96, incl.)	67	44	3	6	16	.....	5	2	2	.....	4	.....
Diseases of the respiratory system (Chart Nos. 97 to 107, incl.)	260	87	326	57	4	.....	110	2	19	.....	280	.....
Diseases of the digestive system (Chart Nos. 108 to 127, incl.)	479	250	1,007	190	48	.....	121	4	49	.....	877	.....
Non-venereal diseases of the genitourinary system and its adnexa (Chart Nos. 128 to 142, incl.)	11	17	10	10	4	.....	4	1	1	.....	21	.....
The puerperal state (Chart Nos. 143 to 150, incl.)	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Diseases of the skin and of the cellular tissue (Chart Nos. 151 to 154, incl.)	117	25	181	60	67	3	78	4	46	.....	131	.....
Diseases of the bones and of the organs of locomotion (Chart Nos. 155 to 158, incl.)	135	59	14	5	8	.....	20	1	23	.....	111	.....
Malformations (Chart No. 159)	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Diseases of early infancy (Chart Nos. 160 to 163, incl.)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Old age (Chart No. 164)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
External causes (Chart Nos. 165 to 203, incl.)	886	173	353	55	687	14	788	18	327	.....	1,467	.....
Ill-defined diseases (Chart Nos. 204 and 205)	29	124	245	172	4	.....	508	7	.....	.....	.....	.....
TOTALS	2,396	976	2,261	605	945	19	1,707	45	547	.....	3,292	.....

* NOTE.—This table gives only cases treated, and does not show the number of treatments.

There were three cases of quarantinable diseases aboard our steamships during the year. There was 1 case of trachoma (Chinaman in transit); and 3 cases of venereal diseases among the passengers, and 45 cases of venereal diseases among members of the crews.

The chart numbers used are taken from the "International List of Causes of Sickness and Death." These chart numbers are used universally by public-health and city and state health departments and organizations.

† Including 19 members of crew and 3 passengers treated aboard the S. S. "Abangarez," during one voyage beginning and ending at New York, N. Y.

EXPLANATORY NOTES

The map, which appears in the front of this Report, will indicate the approximate locations of the various Divisions:

The *Tela Railroad Company*, the *Truxillo Railroad Company*, and the *Cortes Development Company* are situated on the Atlantic coast of Honduras, with headquarters at Tela, Puerto Castilla and Puerto Cortes, respectively. No reference to the Cortes Development Company appears in Reports prior to 1930.

The *Preston Division* and the *Banes Division*, which have been consolidated in this Report under the heading of "Cuban Divisions," are situated on the northeast coast of Cuba, with headquarters at Preston and Banes respectively.

The *Panama Division* is situated on the Atlantic coast of Panama, with headquarters at Almirante; while the *Chiriqui Land Company* is situated on the Pacific coast of Panama, with headquarters at Puerto Armuelles. The Medical Department of the Chiriqui Land Company was organized in 1929—hence, the Reports prior to that year contain no reference to that Division.

The *Compania Bananera de Costa Rica* is situated on the Atlantic coast of Costa Rica, with headquarters at Port Limon. Prior to the year 1930, the statistics for that Division appeared in the Reports under the heading of "Costa Rica Division."

The *Guatemala Division* is situated principally on the Atlantic coast of Guatemala. The Hospital is located at Quirigua, about sixty miles inland from Puerto Barrios.

The *Colombia Division* is situated on the Atlantic coast of Colombia, with headquarters at Santa Marta.

The *Jamaica Division* is situated on the island of Jamaica, B.W.I. The Medical Department in the Jamaica Division functions somewhat differently from those in the other Divisions. In Jamaica, employees and their dependents who are seriously ill receive treatments in hospitals operated by the Government. Hence, the medical attention furnished by the Company consists mainly of "first-aid" measures and dispensary service to persons suffering from minor ailments and injuries; although a relatively small number of serious cases among employees are hospitalized in a ward of a few beds reserved by the Company in one of the local hospitals, where they receive professional care from the Company's medical staff. For the reasons mentioned above, the Jamaica Division records very low morbidity and mortality rates for employees—in consequence, the Division is not included in morbidity, mortality, and fatality rates, nor in other vital statistics; and in some tables the disease incidence in that Division is not shown separately, although included in the totals.

Hospital Dispensaries are clinics in charge of physicians, where ambulatory cases are given medical and surgical attention. In most instances, they are in the Hospital or immediately adjoining it; but some of them are situated in outlying parts of the plantations where a large number of people are congregated.

Field Dispensaries are in charge of Dispensers, who are located in more or less isolated sections of the plantations. They treat minor ailments or injuries of ambulatory patients, and render first-aid treatment to more serious cases until they can be transported to the Hospital.

The term "Employees" embraces all persons appearing on our payrolls, including laborers and others employed on a part-time or hourly basis.

The term "Non-Employees" includes all persons formerly indicated by the classifications "Members of Families of Employees" and "Other Non-Employees" —i.e., all persons not included in the term "Employees."

The chart numbers appearing in some of the tables are taken from the "International List of the Causes of Sickness and Death." These chart numbers are used universally by public health departments and organizations.

A list of abbreviations used in the tables in Section V, with their meanings, is given herewith:

M.—Male
F.—Female
T.—White persons born in temperate zones
O.—All persons other than "white persons born in temperate zones"
Emp.—Employee
Non-Emp.—Non-Employee
Pass.—Passenger
Pos.—Positive
N. Y.—New York
N. O.—New Orleans

It will be noted that dependents are separated into two groups—(1) White persons born in temperature zones, and (2) "Others." The latter group includes all individuals, *irrespective of color or race*, except white people with nativity in temperate zones. This method affords an opportunity to determine the effects of climatic conditions on white people born in temperature zones and residing in a tropical climate. The term "Others" has no racial significance; and that classification includes children born in the tropics, whose parents are classified as "White persons born in temperature zones."

SPECIAL COMMENT

The author of each paper is afforded an opportunity to give free expression to his own ideas on the subject of the article, and it is understood that he is solely responsible for the opinions expressed and the statements made therein.

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